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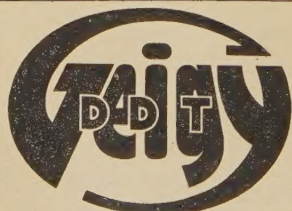
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- BALD (J. G.) & NORRIS (D. O.). **Transmission of Potato Virus Diseases. 1. Field Experiments with Leaf Roll at Canberra, 1940-41.**—*Bull. Coun. sci. industr. Res. Aust.* no. 163 pp. 5-18, 2 figs., 4 refs. Melbourne, 1943.
- NORRIS (D. O.) & BALD (J. G.). **2. The Aphis Population of Potatoes at Canberra during 1940-41.**—*T.c.* pp. 19-31, 5 figs., 12 refs.

In the first paper, a detailed description is given of a field experiment on the dissemination by Aphids of leaf-roll of potato [*Corium solani* of Holmes] carried out at Canberra in 1940-41 and designed to determine whether the findings of workers in other countries on the importance of apterous Aphids migrating from plant to plant are applicable under conditions in Australia. The experiment was performed in two parallel blocks of potatoes five yards apart, that were planted on 25th November and 19th December, respectively. They were 20 yards long from west to east and were separated at the western ends by about eight and five yards, respectively, from a strip of heavily infested commercial plants of another variety that were just through the ground when the first block was planted. The blocks contained a number of sub-plots, each comprising six plants, of which one in each of half of the sub-plots was infected with leaf-roll. Tubers from each plant were planted in the following year, and records kept of the infection that developed. The statistical treatments to which the data were subjected are described.

Steep gradients of infection that were associated with differences in the Aphid populations occurred in both blocks, the heaviest infection being in the rows nearest to earlier-planted potatoes. Alates were scarce in the commercial potatoes when the plants in the first block appeared above ground, and as the gradient of infection in it was later very steep, it is concluded that, where populations are small and infection centres fewer than in the experiment, 20 yards of crop provides a considerable barrier to mass migrations from outside sources of infection. There were no alates in the first block. When the plants in the second appeared the latter became infested, probably by apterous Aphids crawling from the first block or the commercial potatoes. Alates were later relatively numerous in both blocks, and the gradients of infestation were gradually eliminated.

The percentage of infection among plants adjacent in the row to a diseased plant was higher than among more distant plants in the second block, but not in the first. This is attributed to differences in the growth of the foliage, which formed a continuous mass that prevented cultivation of the soil in the first block and which did not touch between the rows, enabling cultivation to be continued late into the season, in the second. The elimination of the effect of the source plants in the first block might have been due to a high proportion of infected Aphids among the alates entering it from an outside source; this is not considered likely, however, since alates were numerous when the plants in the second block were at a susceptible stage, but the effect of the source plants remained obvious. From data obtained in the second plot, direct transmission to adjacent plants was estimated to provide 78 per cent. of the infection among these plants. Apart from a tendency to move along the row, there appeared to be no strong directional influence in the movements of individual Aphids. The migration of apterous Aphids from the infected source is not considered to be the only factor responsible for transmission, however, as in that case the short-range gradients should have been more apparent and it is estimated that only 34 per cent. of the plants in the sub-plots containing a diseased source plant and 5 per cent. of those in the controls, would have become infected, whereas the actual percentages were 78 and 68. It is calculated that infection from indirect sources, such as the migration of infected alates, secondary infection from plants that became infected during the current season, or infection of a series of plants by Aphids migrating considerable distances along

the rows, could alone produce a mean infection of 66 per cent. throughout the block.

Some of the results in the second paper, in which the fluctuations in the populations of *Macrosiphum solanifolii*, Ashm. (*gei*, auct.) and *Myzus persicae*, Sulz., in the experimental blocks and the commercial potatoes are discussed with reference to the weather during the summer of 1940-41, have already been noticed [*R.A.E.*, A 32 140]. Most of the fluctuations in numbers of both species from week to week were due to variations in the numbers of nymphs, and the ratio between these and the adults was found to provide a useful measure of changes that were not otherwise apparent. *Macrosiphum* was the prevalent species during the greater part of the summer, *Myzus* usually being present only in small numbers. Hot, dry weather at the beginning of December caused populations of both species to decline and remain at a low level until the onset of moderate temperatures and high humidity in January and February. A peak occurred in the middle of February, but numbers again decreased with a temporary return of hot, dry weather. Other causes of fluctuations were the immigration of alates of *Macrosiphum* from outside the experimental area in November, when conditions favoured Aphid flight [24 552], and the higher number of both species that occurred on young plants; it is suggested that mortality may be higher on the older plants, owing to greater exposure, or that there is a tendency to migrate from them, or that they may provide a less suitable food source, as a result of which fewer young are produced.

After heavy falls of rain in January and February, populations of *Myzus* were low and immature stages scarce, whereas for *Macrosiphum* the converse was the case. This is attributed to the fact that nymphs and adults of *Myzus* cling to the leaves when disturbed by rain, which readily injures or kills both, but particularly the more delicate nymphs. The nymphs of *Macrosiphum* also cling to the leaves, but are less easily killed, as their bodies are tougher, but the adults drop to the ground where they are likely to be killed by the rain before they can shelter among the lower leaves; many adults that were displaced by rain from the middle leaves of the plants found shelter among the lower ones, leaving a predominantly nymphal population on the middle leaves, among which mortality was extremely high during the next heavy rainstorm.

Both species were most numerous among the lower leaves and least numerous on the top ones; workers in other countries have found this to be the normal distribution for *Myzus*, but not for *Macrosiphum*, which is generally more abundant among the top leaves. High temperatures and strong winds prevail during the growing season of potatoes at Canberra, however, and *Macrosiphum* probably migrates to the lower leaves to obtain shelter from these unfavourable conditions. Furthermore, the rate of reproduction appears to be greater among Aphids in this situation, either owing to the more favourable environment, or to a decrease in the mortality among the nymphs, the latter being considered the more likely.

LOEWEL (E. L.). **Dinitro-ortho-kresol als Winterspritzmittel im Obstbau.** [Dinitro-o-cresol as a Winter Spray for Fruit Trees.]—*Kranke Pflanze* 21 no. 1-2 pp. 8-10. Dresden, 1944.

In view of a recent paper by Thiem [*R.A.E.*, A 32 143], the author discusses the results of experiments in recent years in the Altenland district of Germany on the use of dinitro-ortho-cresol as a dormant spray for fruit trees. It was equally effective whether obtained as a powder or as a paste. A concentration of 0.5 per cent. dinitro-o-cresol in the spray was necessary to kill Aphid eggs, and even this was not sufficient against *Eriosoma lanigerum*, Hsm., on apple since the liquid did not penetrate well to the individual Aphids.

A comparison with a tar distillate of the heavy-oil type showed that the latter was superior to dinitro-o-cresol, especially against *Psylla mali*, Schm., on apple in December, but that dinitro-o-cresol was the more effective in March. Spring applications of dinitro-o-cresol are therefore recommended, and all the more since *Anthonomus pomorum*, L., requires a relatively late treatment.

A combined spray of Bordeaux mixture and dinitro-o-cresol was not satisfactory since the fungicide should be applied later for good control of *Fusicladium* and the combined spray was less effective than the cresol alone against *Operophtera brumata*, L., and Aphids. Separate applications are therefore preferable.

The use of dinitro-o-cresol had no harmful effects on cattle, though fowls were more susceptible. It is preferred to carbolineum by workers, since it does not scorch the face, and is recommended as the most effective winter spray yet available.

AHLBERG (O.). **Olika morotsorter och morotflugan.** [Different Varieties of Carrots and the Carrot Fly.]—*Växtskyddsnotiser* 1944 no. 4 pp. 49–50, 1 fig. Stockholm, 1944.

Plot tests in Sweden with carrots of eight varieties showed that their attractiveness to ovipositing females of the carrot fly [*Psila rosae*, F.] varied considerably, the percentage infestation by larvae of the first generation ranging from 3 to 53. It is thought that there would not be much reduction in damage if an apparently resistant variety were sown alone, but a trap crop of a susceptible variety might afford some protection to a more resistant one.

TUNBLAD (B.). **Bekämpningsförsök mot löckvalster.** [Experiments on the Control of the Bulb Mite.]—*Växtskyddsnotiser* 1944 no. 4 pp. 53–58. Stockholm, 1944.

Hyacinth bulbs reaching Sweden in 1943 showed an unusually high degree of infestation by the bulb mite [*Rhizoglyphus echinopus*, Fum. & Rob.]. Infested bulbs were formerly refused entry, but it is now hoped that it may be possible to allow it on condition that the material is satisfactorily disinfested on arrival. The method commonly recommended is fumigation with paradichlorbenzene, and experiments were therefore carried out with infested hyacinth bulbs of two varieties to test this and other possible methods.

The results, which are given in detail and discussed, showed that fumigating the bulbs for two days at a temperature of 20°C. [68°F.] with paradichlorbenzene scattered in sacking between the layers at the rate of 0.2 oz. per sq. ft., except for the bottom layer, for which it was 0.4 oz., so that it did not touch the bulbs themselves, killed almost all the mites but severely injured the bulbs, so that they developed very few or no roots and mostly poor or no blooms.

Of the other methods tested, fair control of the mite was given by fumigation with naphthalene under the same conditions as those used for paradichlorbenzene, and immersing the bulbs for 2½ hours in water at a temperature of 40–43.5°C. [104–110.3°F.], neither of which methods injured the bulbs. A proprietary preparation was also fairly effective. Fumigation for 3 hours with hydrocyanic acid gas from Cyanogas calcium cyanide applied at the rate of 2 oz. per 10 cu. ft., immersion for 1 hour in 5 per cent. lime-sulphur (22° Bé) or for 10 minutes in hot water (55°C. [131°F.]) and exposure for 15 minutes to hot air (45 or 60°C. [113 or 140°F.]) were relatively ineffective.

The control bulbs developed hardly any injury by *Rhizoglyphus*, and this is attributed to the low temperatures to which they were exposed and the fact that they were well dried. Little is known as to the actual effect of damage by the mite, though it is considered to have been much exaggerated in the past; infestation is doubtless favoured by damp and warmth, and its chief importance may lie in the fact that it facilitates attack by fungi and bacteria.

MÜHLOW (J.). **Åkertripsen som skadedjur på oljeväxter.** [*Thrips angusticeps* as a Pest of Oil Plants.]—*Växtskyddsnotiser* 1944 no. 4 pp. 58–59, 2 figs. Stockholm, 1944.

Thrips angusticeps, Uzel, which was first observed in Sweden in 1922, when it attacked turnips, caused considerable injury to two fields of spring rape there in 1944. Most of the infested area had been under flax in the preceding year. Infestation was absent from a patch that had been under potato and much reduced on one from which soil had been removed. This is taken to indicate that the thrips overwinters in the ground.

MÜHLOW (J.). **En för Sverige ny bladlus på päronträd.** [An Aphid new to Sweden on Pear.]—*Växtskyddsnotiser* 1944 no. 4 pp. 60–61, 1 fig. Stockholm, 1944.

Anuraphis (*Yezabura*) *piri*, Boy., which had not previously been recorded from Sweden, was found there in July 1944 on pear trees interplanted with apple; the apples were not infested. The Aphids were extremely numerous on the stems and main branches of the pears and also occurred on the leaves and shoots. They were commonest in cracks in the bark. The trees were immediately carefully sprayed with 0.1 per cent. nicotine, and three weeks later no living Aphids could be found. Spraying was continued at 3 per cent., and it is hoped that the infestation has been eradicated.

SCHWAN (B.). **Bina och skadedjursbekämpningen.** [Bees and Pest Control.]—*Växtskyddsnotiser* 1944 no. 4 pp. 61–63. Stockholm, 1944.

The author points out that though some protection is afforded to honey bees in Sweden by the regulations concerning the use of arsenicals on fruit trees [R.A.E., A 32 434], these insecticides are now being widely applied there to rape and white mustard, which are much frequented by bees. A case is cited in which bees kept next to a rape field so dusted were almost all destroyed by arsenical poisoning. It is therefore desirable that other methods of pest control should be used in rape fields, and it is stated that Gesarol [of which the active principle is 2,2-bis (parachlorophenyl)-1,1,1-trichlorethane] has been found effective in Germany against the rape beetle [*Meligethes aeneus*, L.]. Though this material is toxic to bees in the laboratory, recent experiments in Germany have shown that there is no danger to them when rape fields are treated with it, since bees from a hive placed in a field dusted during the flowering period at three times the normal rate suffered no harm.

LEFÈVRE (P. C.). **Introduction à l'étude de *Helopeltis orophila* Ghesq.**—*Publ. Inst. nat. Etude agron. Congo belge* Sér. sci. no. 30, 46 pp., 6 pls., 6 graphs, 8 refs. [Yangambi] 1942. Price Fr. 45. [Recd. 1944.]

A detailed account is given of experiments still in progress on the bionomics and control of *Helopeltis orophila*, Ghesquière, on *Cinchona* in the Belgian Congo [cf. R.A.E., A 32 417], together with descriptions of all stages and of four colour forms [28 437]. Feeding by this Capsid, all stages of which are present throughout the year, causes necrotic areas to appear, mostly along the secondary veins of leaves, and the leaves become curled. On trees infested for some time, the growth of the terminal buds may be arrested, and a proliferation of secondary and sometimes tertiary lateral growth may arise; similar proliferations result from infestation by *Coccus hesperidum*, L. Cankers are produced on shoots attacked by *H. orophila*, which also feeds on the flower buds and capsules. The production of bark is retarded in infested trees, which appear to be most seriously damaged when 2–3 years old, the effects becoming apparent in a smaller

increase in height and diameter about a year later. In experiments with 27 food-plants, all of which were attacked in the laboratory, *Cinchona calisaya* var. *ledgeriana*, *C. succirubra*, *Eucalyptus* sp. and castor (*Ricinus communis*) were preferred [cf. 32 417]; it is concluded that the Capsid lived on native plants before *C. calisaya* var. *ledgeriana* was cultivated as a crop. The importance of destroying castor in or near plantations is emphasised. The Capsid was observed in large numbers on a native tree, *Maesa rufescens*, on the edge of a forest; the proportions of the different stages present were similar to those on *Cinchona*. Five leguminous shade and cover plants were found in the laboratory tests to be attacked to varying degrees.

The numbers of *H. orophila* were largest in July–August, when rainfall was low and smallest in October–November, when it was high; heavy hail falling for 15 minutes reduced a population by 39 per cent., the fifth-instar nymphs and adults being most affected. In general, infestation of *Cinchona* appears to be heavier at high than at low altitudes, where the trees are more vigorous and the air less humid; infestations on tea growing near *Cinchona* were very low at 6,900 ft., however, and no greater than at 5,400 ft. High temperatures appear to be unfavourable, and owing to the weak powers of flight of this Capsid, it occurs most frequently on plants in hollows and on slopes sheltered from the prevailing wind; on level ground, the breeding centres are in line with the direction of the prevailing wind. The physical condition of the plant renders it less able to withstand infestation in the dry season, when *H. orophila* is most abundant, and damage is greater at that time, although each Capsid then makes fewer feeding punctures than in the rainy season, when the cell-sap is less concentrated. Infestation was light on *Cinchona* trees that formed continuous cover; in a plantation of trees of uniform age bordered by two rows of *Eucalyptus*, the trees that were overshadowed by the *Eucalyptus* were damaged most.

The parasites of this Capsid [cf. 32 417] comprised *Sarcophaga* sp. and *S. misera*, Wlk., which were reared from fifth-instar nymphs and adults, but were found only during the rainy season of 1939–40, an unidentified Hymenopterous parasite of the nymphs and adults, and *Euphorus miridicidus*, Ghesquière, which was reared from adults and nymphs in the fourth and fifth instars. The percentage parasitism by this Braconid at two places at altitudes of 6,890 and 5,413 ft. during the first seven months of 1939 is shown in graphs; the averages were less than 0.8 and 1.2, respectively.

Jarring the trees and destroying the Capsids that fall and the hand-collection of the various stages were both shown to be of little value in control. The chief insecticide tested was pyrethrum, which is readily available; dusts are considered to be more suitable than sprays under conditions in the Belgian Congo. The percentage control given in 23 plantations by an application of pyrethrum in the dry season varied from 53.10 to 98.65 and in all but two cases exceeded 76; variations in effectiveness are attributed to differences in the age, development and spacing of the trees. The author gives a formula for the coefficient of effectiveness of an insecticide in which the percentage mortality observed in the field is multiplied by 10 and divided by the times (in hours) required in a laboratory test for complete mortality and for the rate of mortality per hour of the most resistant stage to reach its maximum. Data collected in order to apply it showed that fifth-instar nymphs are most resistant to pyrethrum. Two applications of insecticide separated by an interval of 18–19 days should be made. The cost of dusting trees exceeding 6½ ft. in height was high and the results were not entirely satisfactory, but damage to trees over six years of age appears to be of little importance. The best results were obtained when pyrethrum dust was mixed with four times its volume of wood ash to give a pyrethrum content of 0.204 per cent.; derris dusts containing 0.5 or 0.75 per

cent. rotenone were almost as effective. In tests with sprays an extract prepared by filtering oil of the kerosene type in which pyrethrum powder at the rate of 1 lb. per gal. had been steeped for 24 hours was found to be toxic to *Systates* spp., which are common on *Cinchona*, as well as to *Helopeltis*; 70 cc. were required for a tree $4\frac{1}{2}$ years of age. Its coefficient of effectiveness was calculated to be 51.428 as compared with 0.865 for pyrethrum dust, but the difference was almost entirely due to the time factors. It was also very effective when emulsified in four times its volume of water. A proprietary preparation containing pyrethrum gave fairly good results, but solutions of soap with or without 2 per cent. nicotine were of little value. The cost of the various treatments is discussed.

WATERSTON (J. M.). **Plant Protection in Bermuda.**—*Bull. Dep. Agric. Bermuda* no. 21 [3+] ii+102 pp. Hamilton, 1943.

The measures available for the protection of plants against insect and other pests and diseases in Bermuda are discussed under the headings: Cultivation of Resistant Varieties; Plant Sanitation; Cultural Measures; Use of Chemicals; Mechanical and Physical Methods; Biological Control; and Legislative Control. Numerous formulae are given for insecticidal sprays and dusts, poison baits, repellents and seed dressings, as well as notes on the use of fumigants, and three tables, dealing with crop plants, fruit trees and ornamental plants, respectively, show the various insects and diseases of importance in Bermuda, with the measures recommended against them. The antidotes for a number of poisons are given on the back cover.

BRIERLEY (P.) & SMITH (F. F.). **Studies on Lily Virus Diseases: the Mottle Group.**—*Phytopathology* 34 no. 8 pp. 718–746, 11 figs., 19 refs. Lancaster, Pa., 1944.

The following is taken mainly from the authors' summary. Three mottle viruses from lilies in the United States, a latent type from *Lilium tigrinum* (LT), the strong or coarse mottle (CM) of Easter lily (*L. longiflorum*) and a more virulent mutant from the latter (VCM) were compared with McWhorter's tulip-breaking viruses (TV1 and TV2) in Easter lily, *L. formosanum*, *L. tigrinum* and tulip. The properties of the five viruses are described. The host range of CM was found to be limited to Liliaceae, including *Calochortus* sp., *Fritillaria pudica*, tulips and *Zygadenus fremontii* in addition to several species of *Lilium*. The known ranges of the other four viruses are similar, except that VCM affects *Ornithogalum thyrsoides* also. CM was transmitted by *Aphis gossypii*, Glov., *Macrosiphum solanifolii*, Ashm., and *Myzus persicae*, Sulz., but not by *M. circumflexus*, Buckt., *Macrosiphum solani*, Kalt. (*Myzus convolvuli*, Kalt.), or *Macrosiphum lilii*, Monell. *Myzus persicae* carried all five viruses with high efficiency. *A. fabae*, Scop., and *A. gossypii*, in addition to the previously established vectors *Macrosiphum solanifolii* and *Myzus persicae* [cf. R.A.E., A 27 369, etc.], transmitted virus from Rembrandt tulips infected with TV1 and TV2 in mixture to *Lilium formosanum*. CM, naturally or experimentally established in Easter lilies, was found to offer complete protection against further addition of CM or of VCM. TV1, TV2 and LT similarly established in Easter lily offered no protection against subsequent addition of VCM. LT failed to protect *L. tigrinum* against CM, which produces killing effects in this lily. Over 12,000 seedling Easter lilies grown from seed of diseased parents showed no evidence of seed carriage of any lily virus. It is suggested that the five viruses studied be considered strains or subspecies of tulip-breaking virus, which *Marmor tulipae*, Holmes, may be amended to

describe, and which will correspond to *Tulipa virus 1* (Cayley) Smith, if the alleged hosts *Hyacinthus* and *Narcissus* are omitted. VCM is considered a mutant from CM that appears in Easter lily stocks carrying CM.

More or less seasonal waves of migrant Aphids are mainly responsible for the prevalence of mottle viruses in lilies. Alates of *Myzus persicae* are produced in numbers on cruciferous crops or potatoes when their favoured food-plants mature or become heavily infested. They do not prefer lilies as food-plants or carry any virus to them, but, if they encounter lilies, they feed briefly on a great many individual plants and are thus highly efficient vectors of mottle viruses that are already present.

DAINES (R. H.). **Lime in the post-arsenical Sprays as a Means of reducing arsenical Injury to Peaches.**—*Phytopathology* **34** no. 8 pp. 763-764, 2 refs. Lancaster, Pa., 1944.

Previous workers have shown [*R.A.E.*, **A** **16** 142; **29** 42] that calcium hydroxide reduces, and calcium carbonate in the absence of calcium hydroxide increases, the amount of soluble arsenic formed from lead arsenate in a water solvent. In New Jersey, arsenical injury to peach foliage often appears as long as a month after the last arsenical spray, probably because of the carbonation of the lime present or the removal of the calcium hydroxide by weathering. Three tests were made on peach trees in 1943 to determine whether lime in the post-arsenical sprays would prevent the occurrence of this delayed injury. The arsenical sprays contained 2 lb. acid lead arsenate, 8 lb. sulphur and 0, 6 or 16 lb. high-calcium hydrated lime per 100 U.S. gals. water. They were applied twice in the first two tests, at the times of the sepal-split and first cover applications, and once in the third, about six weeks after the sepals split. All the trees then received a spray of 8 lb. sulphur per 100 U.S. gals. water with or without the addition of 8 lb. hydrated lime, 12-19 days after the last lead-arsenate spray. In the first test, environmental conditions were not conducive to arsenical injury, and no advantage was seen from the use of the delayed lime application. In the other tests, the results of which are shown in detail in a table, injury by the lead-arsenate sprays containing 0 or 6 lb. lime was considerable and was much reduced by the use of lime in the post-arsenical spray, but injury by the lead-arsenate sprays containing 16 lb. lime was negligible on all trees.

THOMPSON (R. C.), DOOLITTLE (S. P.) & SMITH (F. F.). **Investigations on the Transmission of Big Vein of Lettuce.**—*Phytopathology* **34** no. 10 pp. 900-904, 4 refs. Lancaster, Pa., 1944.

The following is taken from the authors' summary of recent experiments in Virginia on the transmission of big vein of lettuce, a disease that was reported in 1934 to cause considerable loss in California and now appears to be widely distributed in the principal lettuce-growing districts of the eastern United States. The data given show that the disease is soil-borne and that the virus can be inactivated by steam treatment of the soil. It could not be transmitted by mechanical inoculation. The experiments on insect transmission were not extensive enough to justify definite conclusions, but indicated that the root Aphid, *Pemphigus lactucae*, Fitch, might be a vector.

JONES (L. K.). **Leaf Roll of Potato in Washington.** (Abstract.)—*Phytopathology* **34** no. 10 p. 935. Lancaster, Pa., 1944.

The virus of leaf-roll [*Corium solani* of Holmes] has become very injurious to potatoes in central Washington since 1938. It spreads rapidly and infection takes place from the time that the plants appear until the end of the growing

season. It has been transmitted by grafting and by *Myzus persicae*, Sulz., *Macrosiphum solani*, Kalt. (*Myzus pseudosolani*, Theo.), and *M. solanifolii*, Ashm., but not by mechanical inoculation. Its extensive dissemination early in the season, however, suggests that insects other than Aphids may also be vectors. The yield of potatoes was reduced by about 85, 70 and 40 per cent. when 100, 25-30 and 12-15 per cent., respectively, of the planting tubers were infected. Early current season infection reduced yields by about 35 per cent., but late current season infections caused little or no reduction.

KIMMEY (J. W.) & FURNISS (R. L.). **Deterioration of Fire-killed Douglas-fir.**—*Tech. Bull. U.S. Dep. Agric.* no. 851, 61 pp., 20 figs., 16 refs. Washington, D.C., 1943.

The following is based on part of the authors' summary of this account of studies on deterioration in wood of Douglas fir (*Pseudotsuga taxifolia*) killed by fire, made in western Oregon and Washington in 1934-39 to provide data from which a comprehensive scheme for salvage operations could be planned. Fungi and insects were found to be the principal causes of deterioration, and were usually closely associated and often interdependent in their action. Insects characteristically cause only partial deterioration, and wood attacked by them alone can be used as low-grade timber. They can be classified according to whether they attack the phloem region, the sapwood or the heartwood, but some species infest more than one. *Dendroctonus pseudotsugae*, Hopk., is the most important of those that feed in the phloem and, in addition to loosening the bark and introducing a blue-stain fungus (*Ceratostomella pseudotsugae*), it also constitutes a danger to living trees. *Melanophila drummondii*, Kby., is of somewhat less importance, but more injurious than several other phloem-feeding insects. *Trypodendron lineatum*, Ol. (*bivittatum*, Kby.), *Gnathotrichus retusus*, Lec., and *G. sulcatus*, Lec., lower the grade of the sapwood by constructing their galleries in it and introducing blue-stain fungi. Several other borers mine principally in the sapwood and cause some deterioration, but most, including certain Siricids, Buprestids and Longicorns enter too late to be of much importance. Some Longicorns, of which *Ergates spiculatus*, Lec., *Criocephalus productus*, Lec., *Asemum atrum*, Esch., and *Strangalia (Leptura) oblitterata*, Hald., are the most injurious, cause considerable damage to heartwood that is otherwise sound, but, in general, attack in this region is relatively rare. The presence of galleries of *E. spiculatus* or *C. productus* may determine the practical limits of salvage under existing economic conditions. *Platypus wilsoni*, Swaine, occasionally mines in heartwood, but is not of great economic importance.

Deterioration caused by both fungi and insects starts just under the bark and progresses fairly uniformly inwards. Trees killed by fires in undisturbed forest areas where many of the insects that cause deterioration are relatively uncommon are less likely to be heavily attacked than those near areas where trees have previously been killed by fire or blown down by wind, and the amount of damage due to borers was found to be correlated with nearness to such areas. Rapid deterioration near the centre in individual trees may be due to the building up of insect populations, as a result of which the amount of available wood is diminished and the galleries may be extended more rapidly into the wood.

MICHELbacher (A. E.). **The present Status of the Alfalfa Weevil in California.**—*Bull. Calif. agric. Exp. Sta.* no. 677, 24 pp., 12 figs., 39 refs. Berkeley, Calif., 1943.

This bulletin deals primarily with the status of *Hypera variabilis*, Hbst. (*postica*, Gylh.) on lucerne in lowland central California, as this is where it has access to an important lucerne-growing area. A survey is given of its bionomics

and spread in California, together with a discussion of the influence of weather conditions on the various stages and the number of generations that occur annually in different parts of the State and elsewhere, and notes on control by cultural measures and by the introduced Ichneumonid parasite, *Bathyplectes curculionis*, Thoms. Most of the information has been noticed from other sources [*R.A.E.*, A **23** 554; **29** 401-403, etc.]

The weevil has been observed breeding in the field in California on lucerne (*Medicago sativa*), *M. hispida*, *M. lupulina*, and sweet clovers (*Melilotus indica* and *M. alba*), which are probably preferred in the order given, and in the laboratory it has completed its development on *Melilotus hubamensis* and vetches (*Vicia dasycarpa* and *V. villosa*). Its control by *Bathyplectes* has been more effective in the San Francisco Bay area than in the north-western part of the San Joaquin Valley [**29** 409; **30** 307], but its numbers are in general very small even in the latter area and it is not an important pest. It was most injurious in 1940, when several fields in one district were almost defoliated. Injury was much less in the following year, and there was no serious damage in 1942. Control by an insecticide [**20** 680] has not been found necessary in California.

DOMINICK (C. B.). **Life History of the Tobacco Flea Beetle.**—*Bull. Va agric. Exp. Sta.* no. 355, 39 pp., 12 figs., 9 refs. Blacksburg, Va., 1943.

All stages of *Epitrix hirtipennis*, Melsh., are briefly described, and a detailed account is given of the results of investigations on its bionomics in Virginia in 1938-41, some of which have been noticed from previous papers [*R.A.E.*, A **28** 172; **29** 200; **30** 186, 187]. It is recorded as *E. parvula*, F., in these papers and constantly in others from the United States, because the two species were erroneously considered identical, but H. S. Barber, who identified Virginian adults as *E. hirtipennis*, has found that it is the common tobacco flea-beetle of the United States and that, although both species are present in Florida, South Carolina and Texas, and the West Indian *E. parvula* may possibly occur in other States, no biological data on the latter seem to be available.

The following is mainly based on part of the author's summary. The adults of *E. hirtipennis* feed on the aerial parts of tobacco plants and the larvae on the roots, and injury may be severe, particularly in the seed-beds and during hot, dry weather. Four generations were reared in 1938 and 1939 and three in each of the other years. The adults began to emerge from hibernation about the middle of March and emerged in large numbers when the temperature reached or exceeded 80°F. In the autumn, beetles were first found in hibernation about the middle of September. The egg, larval, prepupal and pupal stages occupied 3-24, 13-44, 1-8, and 3-25 days; the length of the life-cycle varied from 20 to 67 days. Males and females caged on emergence from hibernation survived for up to 96 and 131 days, respectively, but practically all overwintered adults in the field had disappeared by mid-June. Eggs were deposited in crevices in the soil about the plants, generally beneath leaves in contact with the soil. The maximum number laid by a single female was 327, and the maximum duration of the oviposition period was 53 days. Few eggs were deposited at temperatures as low as 65°F., and none at 50°F.; adequate moisture appeared to be a determining factor in oviposition. Females represented 60 per cent. of the beetles trapped on adhesive screens in 1940.

Insect enemies included the predacious Lygaeid, *Geocoris punctipes*, Say, and the Braconid parasite, *Microctonus epitricis*, Vier. [**30** 187], both of which attacked the adults. A fungus of the genus *Penicillium* infested pupae in the rearing cages, particularly when the damp sand that provided the normal medium in the cages was replaced by soil collected in the field.

LATHROP (F. H.) & DIRKS (C. O.). **Timing the seasonal Cycles of Insects.**—*J. econ. Ent.* **37** no. 2 pp. 199–204, 6 figs., 1 ref. Menasha, Wis., 1944.

Since timing the seasonal cycles of insects is of primary importance in economic entomology, a critical study was made of a series of records of the life-histories of *Rhagoletis pomonella*, Walsh, *Conotrachelus nenuphar*, Hbst., *Callimome druparum*, Boh., and *Saperda candida*, F., on apple in Maine in 1933–42, to compare timing in relation to petal-fall of apple with timing by calendar dates. It is considered that petal-fall, which is defined as the time when 75–90 per cent. of the petals have dropped, provides an almost ideal date for timing seasonal events, as it is usually sharp and lasts for only a brief period. The date should be based on known varieties of apples, and consideration should be given to the relative time of petal-fall in different varieties.

The following is based on the authors' conclusions. When records of several years were charted on the calendar-date scale and the phenological scale, the relative positions of the annual records and the summaries of the records varied. When the records included a sufficiently large number of years, the data on each scale approached the form of a normal distribution curve; the means on the two scales approximately coincided, but the deviation from the mean was distinctly less on the petal-fall scale. The use of the phenological scale formed a smoother curve when the records included a comparatively small number of individuals, gave a somewhat better basis for considering data covering several years in one locality and for comparisons of data from two or more separate localities, and made the prediction of the occurrence of events in the life-cycles possible within closer time limits. It seems probable that the phenological scale may form a useful basis for the study of the effect of temperature and other climatic factors that influence the seasonal cycles of insects.

GOODEN (E. L.). **Size Specifications for fine Powders.**—*J. econ. Ent.* **37** no. 2 pp. 204–208, 4 figs., 15 refs. Menasha, Wis., 1944.

The author discusses the drafting of particle-size specifications for insecticidal powders and diluents that are fine enough to pass through the finest testing sieves, which include the ordinary dusting and spraying preparations, and the difficulty of measuring such particles, and concludes that a suitable specification for a given fine powder for use as an insecticide would normally consist of either the surface mean diameter, the approximate maximum limit of diameter or both. The maximum limit is necessary if the presence of an appreciable quantity of material above a certain size would be objectionable because, for example, of the danger of clogging orifices of spray nozzles. The relative importance of the average and maximum sizes depends on the use to which the powder is to be put; if both characteristics are important both must be specified, as there is no dependable correlation between them. The sieve-size specifications should be in terms of the U.S. Standard Sieve Series and should state whether the test is to be wet or dry. The specification of surface mean diameter must include a reasonably definite description of the method of testing. An example of a particle-size specification framed according to these principles is appended.

HARMAN (S. W.). **A Comparison of Dust and Spray Programs for Codling Moth Control.**—*J. econ. Ent.* **37** no. 2 pp. 208–211. Menasha, Wis., 1944.

In view of recent improvements in dusting equipment and the physical properties of dusts and of the present labour shortage, experiments were carried out in western New York to compare the control of the codling moth [*Cydia pomonella*, L.] by dusts, which formerly failed to give adequate commercial control, and a spray [cf. *R.A.E.*, A **31** 501]. McIntosh apples in a

heavily infested orchard received a series of early fungicide sprays, with lead arsenate in the one applied ten days after the calyx spray, followed by six applications of spray or dust at intervals of approximately ten days between 21st June and 23rd August, with an additional treatment on 30th August in the case of the dusts. Each tree received approximately 15 U.S. gals. spray or 2-2½ lb. dust; the dusts were applied to both sides of each row during late evening when air conditions were favourable and dew was present. The spray consisted of 3 lb. lead arsenate, 3 lb. hydrated lime and 8 oz. soybean flour per 100 U.S. gals. water, with the addition of 4 lb. micronised wettable sulphur for the first application and 2 lb. for the others.

Counts of superficial injuries and larval entries in picked and dropped fruit indicated that a dust of a proprietary dusting sulphur and lead arsenate (80 : 20) was less effective than the spray. Dusts of lead arsenate, fixed nicotine (Black Leaf 155) and sulphur (20 : 20 : 60 or 15 : 10 : 75) which gave comparable results, produced approximately the same reduction in deep injuries as the spray and apparently significantly more reduction in the number of superficial injuries. At harvest, the residue from the spray was twice as heavy and that from the dust of sulphur and lead arsenate half as heavy as those from the dust containing fixed nicotine, the bentonite in the latter apparently improving the adhesive properties of the dusts, and control of both scab and *C. pomonella* on the dusted plots was proportional to the quantity of residue.

The relative speed and cost of dusting and spraying are discussed, and it is concluded that under some conditions, dusting for the control of *C. pomonella* may be both effective and relatively cheap.

FELT (E. P.) & BROMLEY (S. W.). **The Insect Menace to Shade Trees in the Northeast.**—*J. econ. Ent.* **37** no. 2 pp. 212-213. Menasha, Wis., 1944.

The authors point out that injury to shade trees in the north-east of the United States is increasing and that their protection against insects is being seriously neglected. Elms have been progressively weakened over a number of years by *Galerucella luteola*, Müll. (*xanthomelaena*, Schr.), *Paleacrita vernata*, Peck, and *Alsophila pomataria*, Harr., and many are now in a condition extremely favourable to attack by *Scolytus multistriatus*, Marsh., which is the principal vector of the fungus (*Ceratostomella ulmi*) that causes Dutch elm disease. Repeated defoliation by *P. vernata*, *A. pomataria*, *Malacosoma disstria*, Hb., and *Lymantria (Porthetria) dispar*, L., weakens oaks and makes them attractive to *Agrilus bilineatus*, Weber; *L. dispar* was exceedingly injurious on Cape Cod in 1943. The exceptionally severe winter of 1942-43 weakened many of the more tender trees and shrubs, and this may result in invasion by borers in the next few years. The more valuable trees in parks should be protected from drought, which produces conditions favourable for *A. bilineatus* in oak, *A. anxius*, Gory, in birch and *Melanophila fulvoguttata*, Harr., in hemlock [*Tsuga*].

On Cape Cod, where pitch pine [*Pinus rigida*] is a desirable shade tree, the turpentine on newly painted buildings among the trees attracts many adults of *Dendroctonus terebrans*, Ol., and *D. valens*, Lec., which usually enter neighbouring trees. Painting in cool weather, especially in autumn, would reduce the probability of attracting the beetles, and spraying the basal four feet of the trunks with lime-sulphur has given promising results in repelling them.

GOODHUE (L. D.) & SMITH (F. F.). **The Effect of some Insecticides in Aerosol Form against the Cyclamen Mite on Snapdragon.**—*J. econ. Ent.* **37** no. 2 pp. 214-218, 1 fig., 5 refs. Menasha, Wis., 1944.

In preliminary tests made in 1942 with 32 insecticides applied as aerosols in dichlorodifluoromethane or methyl chloride for the control of *Tarsonemus*

pallidus, Banks, young snapdragon plants [*Antirrhinum*] with mites well established in the growing tips were exposed to the insecticides for six hours in a Peet-Grady chamber and then returned to the greenhouse. The degree of plant injury was observed and the dead and living mites of all stages in several of the infested tips were counted the following day and a week later. Only a few of the insecticides tested gave a high percentage of mortality; butyl carbitol thiocyanate, diphenyl sulphide and diphenyl sulphoxide were very effective, but caused severe plant injury, and chloratone (a trichlor-tertiary-butyl alcohol) was effective only after standing for several days with methyl chloride, when some chemical reaction had taken place. Acrylonitrile and "lorol" thiocyanate (a term used for a mixture of thiocyanates, principally lauryl thiocyanate, containing 95 per cent. of active materials) were effective and caused no noticeable plant injury and were further tested in the greenhouse; snapdragon plants were exposed overnight, and counts of mites were made two and seven days later. In dichlorodifluoromethane, 25 gm. lorol thiocyanate per 1,152 cu. ft. greenhouse space gave 82.8 per cent. kill at 72–80°F. and 83.9 per cent. at 74–66°, but only 65.5 per cent. at the latter temperature range when the foliage was wet just before treatment; 12.5 gm. killed 94.8 per cent. of the mites at 76° and 12.2 per cent. at 72–58°. In methyl chloride, 25 gm. lorol thiocyanate gave 98.4 per cent. kill at 76–68°, and 12.5 gm. gave 37.3 per cent. at 74–66°; in both cases the kill was somewhat higher than in comparable tests with dichlorodifluoromethane. A mixture of 25 gm. acrylonitrile and 12.5 gm. lorol thiocyanate in dichlorodifluoromethane gave only 22.9 per cent. kill at 78–56°F., and 25 gm. acrylonitrile alone killed no mites at 76–58°. It appears that a temperature above 70°F. is necessary for a high kill with lorol thiocyanate as an aerosol.

In the tests in which high kills were obtained, the surviving mites were generally well protected in malformed tips. As such mites are controlled by repeated sprays, but not by a single one, a further test was carried out in which 25 and 12.5 gm. lorol thiocyanate per 1,152 cu. ft. were applied in 170 and 85 gm. methyl chloride, respectively, once or two, three or four times at weekly intervals from 23rd April to 15th May. Two weeks after the last application, plants treated once had a few injured tips containing living mites, but all those treated two or more times were free from mites. The growth of plants treated with the higher concentration was normal after one treatment; slight injury occurred in some plants treated twice, and stunting in those treated three or four times. No injury was observed on plants treated one, two or three times with the lower concentration, but typical injury and stunting occurred after four treatments. It is evident that two treatments a week apart may be expected to destroy the mites without affecting the subsequent growth of the plants. The results obtained in these tests were confirmed by similar ones in 1943.

The possible value of lorol thiocyanate against other pests is indicated by the fact that it killed all examples of *Myzus persicae*, Sulz., *Aphis gossypii*, Glov., and *Thrips tabaci*, Lind., present on plants in all tests in the Peet-Grady chamber.

HARTZELL (F. Z.) & HORSFALL (J. L.). **A Method for evaluating Treatments for Grape Leafhopper and for analyzing the Heterogeneity of the Infestation.**—*J. econ. Ent.* **37** no. 2 pp. 219–224, 3 figs., 9 refs. Menasha, Wis., 1944.

The following is based on the authors' summary of this account of work carried out in western New York in 1943. A special method for determining populations of *Erythroneura comes*, Say, on grapevines is described. Essentially, it consists of selecting certain leaves, collecting them in paper bags containing calcium cyanide, separating the leafhoppers and determining the total catch by counting the number in an aliquot of the sample, and it has been found to be

rapid, reasonably accurate, and adapted to field studies. The errors due to this manner of counting appear to be no greater than those occurring in duplicate samples from the same vines and give very small discrepancies in calculating percentage control, especially where the efficiency is 75 per cent. or more.

The amount of variation in population was found to be practically as great in different parts of the same vineyard as in different vineyards, and this method of counting furnishes a quick means for determining the degree of heterogeneity and is considered to be as important for this purpose as for evaluating treatments. It should be useful in designing experiments.

GRAYSON (J. M.). **Seedbed and Field Experiments to control Tobacco Flea Beetles.**—*J. econ. Ent.* **37** no. 2 pp. 224–230, 12 refs. Menasha, Wis., 1944.

Although the common tobacco flea-beetle identified by Barber as *Epitrix hirtipennis*, Melsh. [cf. *R.A.E.*, A **33** 41] is usually considered to be most injurious to tobacco plants in the seed-bed, it is often a serious pest in the tobacco field, and experiments on its control under both conditions were therefore carried out in Virginia in 1943.

In the seed-beds, natural cryolite (90 per cent. sodium fluoaluminate), undiluted and diluted with talc to contain 70, 50 and 30 per cent. sodium fluoaluminate and applied at the rate of 1 lb. dust per 100 sq. yards for the first application and $\frac{3}{4}$ lb. for subsequent ones, resulted in an average of 5.9, 7.7, 7.6 and 14.1 per cent. injured leaves, respectively; basic copper arsenate (about 94 per cent.), undiluted and diluted with hydrated lime to contain 50 per cent. active ingredients and applied at the same rates as the cryolite, resulted in 4 and 9.8 per cent. injury; and a mixture of Paris green and lead arsenate (1 : 5), applied at $\frac{1}{2}$ lb. per 100 sq. yards except for the first and second applications in two out of four cases, when it was applied at 1 and $\frac{3}{4}$ lb. per 100 sq. yards, in 8.5 per cent. The injury on untreated plots was 34.8 per cent. The time between applications depended on the frequency of rain and the amount of insect damage occurring in each plot; 3–4 applications were made to most of the plots, though one received as many as seven. All treatments gave significant control. There was no significant difference between sodium fluoaluminate at 90, 70 and 50 per cent. and the mixture of Paris green and lead arsenate. Undiluted basic copper arsenate was not significantly better than 90 per cent. sodium fluoaluminate, but was significantly better than the average of the cryolite treatments. The least effective treatments were 30 per cent. sodium fluoaluminate and 50 per cent. basic copper arsenate. None of the treatments but Paris green and lead arsenate at rates higher than $\frac{1}{2}$ lb. per 100 sq. yards caused any injury. It was more difficult to obtain a uniform coverage of dust with the 90 and 30 per cent. sodium fluoaluminate dusts than with any other treatment. Emergency treatment with natural and synthetic cryolites, diluted with talc to contain 70 per cent. sodium fluoaluminate and applied 2–3 times at the rate of 1 lb. per 100 sq. yards, resulted in 10.07 and 7.35 per cent. injured leaves, respectively, the synthetic cryolite being significantly more effective, but more difficult to apply in uniform amounts.

In field tests, 2.5 per cent. xanthone in talc, applied four times at intervals of about two weeks at successive rates of 18.5, 19, 30.2 and 24 lb. per acre, resulted in an average of 4.79 live flea-beetles per plant, a dust containing 1.5 per cent. dicyclohexylamine dinitro-o-cyclohexylphenate, applied at 12.8, 16.8, 26.3 and 24.6 lb. per acre in 9.913, 50 per cent. basic copper arsenate in talc applied at 9.2, 14.5, 25.7 and 22.4 lb. per acre in 3.183, and synthetic cryolite diluted with talc to contain 70 per cent. sodium fluoaluminate and applied at 12.8, 25.2, 25.2 and 25.7 lb. per acre in 2.93; there were 2.64 live flea-beetles per plant on those wet to run-off with a spray of 6 lb. basic copper arsenate per 100 U.S. gals. water with potash fish oil soap (1 : 1,600), and 12.039 on untreated

plants. The dinitro dust did not give significant control. There was no significant difference between basic copper arsenate spray and dust and sodium fluo-aluminate dust, but the average control given by these treatments was significantly better than that due to xanthone. Xanthone applied at rates above 2.5 per cent. caused bronzing of the tobacco leaves, but none of the other treatments was injurious. A more uniform coverage of dust was obtained with basic copper arsenate and the dinitro compound than with xanthone or sodium fluoaluminate.

GLASGOW (R. D.) & BLAIR (R.). **The Use of Explosives for the Application of Insecticide Dusts.**—*J. econ. Ent.* **37** no. 2 pp. 230-234, 4 figs. Menasha, Wis., 1944.

Since available methods of spraying and dusting forest areas for the control of defoliating insects have many disadvantages, investigations were carried out to determine the practicability of firing insecticide dusts from a mortar. Various types of mortar were tested, and the best was found to be one of rolled and cemented paper, which is light and cheap and not worth recovering after use; the bottom should be so attached as to hold securely against the thrust of the explosion, and the built-up wall need not exceed $\frac{1}{4}$ in. in thickness. Any danger of fire can be avoided by infiltration with a high melting, non-combustible, chlorinated hydrocarbon, such as chlorinated naphthalene, which will also make the mortar waterproof. A charge of Grade A, 4F rifle powder was put in the bottom of the mortar, one end of a safe length of fuse was placed in the powder and the other was allowed to trail over the edge of the mortar, and a disk of heavy cardboard was put over the powder to hold the inner end of the fuse securely in place and to equalise the first thrust of the burning powder. A square of heavy kraft paper was then placed in the mortar to rest on the cardboard disk and folded at the sides to line the mortar to well above the insecticide, which was put in the paper and loosely covered with it; without the paper lining, the drag of the insecticide dust against the sides of the mortar appeared to interfere with the proper lift and mushrooming of the charge. Excellent coverage was obtained at distances much greater than 100 ft. from the mortar, and, when the dust was carried by a light breeze, the agitation of the air continued and good coverage was observed at distances of more than 200 yards; with suitably balanced charges it should be possible to secure almost any lift and dispersion of the insecticide that may be desired. A similar type of cheaper blasting powder might be as effective as the rifle powder. It is suggested that the charged mortars should be put in position the day before dusting and that one man should move rapidly along each row lighting the fuses, either in early morning while the leaves are still wet with dew and conditions are favourable or after an adequate fall of rain.

It is considered that with suitable sizes and positions of mortars, properly designed charges and correct allowance for wind drift, a forest could be thoroughly dusted with an insecticide or fungicide very quickly under the most favourable conditions, and apparently at a very moderate cost; the drive of the many explosions will set up a complicated system of air currents and eddies that should ensure thorough coverage of the foliage, both on the upper and under sides of the leaves, from undergrowth to forest crown.

The possible uses of this method for controlling Anopheline mosquitos is discussed [*cf.* *R.A.E.*, B **32** 61].

DRIGGERS (B. F.). **Oriental Fruit Moth Parasite Liberations and Surveys.**—*J. econ. Ent.* **37** no. 2 pp. 235-237, 5 refs. Menasha, Wis., 1944.

Surveys of the parasites of larvae of the oriental fruit moth [*Cydia molesta*, Busck] feeding in peach twigs in orchards of north, central and south New

Jersey [cf. *R.A.E.*, A **29** 130; **30** 125], were continued during 1941-43. They showed that although *Macrocentrus ancyliivorus*, Rohw., became established and overwintered for one year in northern orchards, it had practically disappeared by the end of the second season. In a discussion of the persistence of this parasite in peach orchards in central and southern New Jersey and its absence or minor importance in those in the north, it is suggested that alternative hosts are lacking in the north; *Ancyliis comptana*, Froel., on which the parasite will readily overwinter, is generally distributed wherever strawberries are grown in the centre and south of the State, but is rare in the north, and both *M. ancyliivorus* and *M. delicatus*, Cress., have been reared from smartweed [*Polygonum*] growing in peach orchards in central and southern New Jersey, where the host is probably *Aristotelia disconotella*, Chamb., and neither species from the same plant in northern New Jersey.

DIRKS (C. O.). **Population Studies of the European Spruce Sawfly in Maine as affected by natural Enemies.**—*J. econ. Ent.* **37** no. 2 pp. 238-242, 1 map, 4 refs. Menasha, Wis., 1944.

The results are given of observations on *Gilpinia hercyniae*, Htg., made in 1937-43 on two plots of mixed woodland in north-central Maine; one contained approximately equal quantities of softwoods, with spruce predominating, and hardwoods, and the other was composed almost entirely of softwoods, also with spruce predominating. In the first, infestation of the spruce trees increased in intensity until 1939, in which year most of them had lost 50-70 per cent. of their old needles by early August, frass from the larvae covered the ground to a depth of half an inch in some places, and an average of 121.8 larvae per catch was obtained by beating them from spruce on a mat 18 sq. ft. in area. There was a marked decline in abundance of larvae and sound cocoons in the subsequent years, and only 1.2 larvae per catch were taken by beating during the summer of 1943. In the second plot, the larvae were most abundant and injurious in 1937 and then decreased. No noticeable defoliation occurred in 1940, 1941, 1942 and 1943, in which years the numbers of larvae taken per catch by beating were 1.3, 2.1, 9.1 and 0.8.

The author discusses the factors that may have reduced the infestation in Maine during 1939-43. Since the sawfly had not consumed as much as 50-70 per cent. of its possible food-supply except in limited areas before the decline set in, it is evident that lack of food was not among them. The percentage of cocoons destroyed by small mammals, Carabid larvae and adults and Elaterid larvae is seldom less than 25-30 or greater than 45-50, and showed no definite increase in either plot during 1939-43. The introduced parasite, *Microplectron fuscipenne*, Zett., attacks a large proportion of the cocoons under favourable conditions; the highest parasitism observed was 43.7 per cent. on the first plot in 1941. The degree of parasitism probably varies inversely with the amount and depth of moss on the ground, as it was evident that the parasite has difficulty in finding sound cocoons that are more than 1-1½ ins. deep, whereas many are at a depth of 2-3 ins. The lower parasitism in 1942 and 1943 may have been due to a scarcity of sound cocoons, as a result of which the population of the parasite was reduced. It persisted in a number of areas of low infestation during these years, indicating that it will be present and should give rapid control if infestation becomes heavy in the future. The sawfly larvae in one plot were attacked by a wilt disease in 1939 [cf. *R.A.E.*, A **29** 531, etc.], and the disease was common on both plots by September 1940. The percentage of diseased larvae averaged 35 in 1940, reached 60-90 or more in 1941 and 1942, when the disease was first observed about the middle of July and fell to less than 25 during 1943, either because of climatic conditions or because the disease was

dying out from lack of host material. It was generally prevalent in areas of both high and low larval population and appears to have been an important factor in the decline of *G. hercyniae*.

TURNER (N.). **Fluorine Compounds as Alternates for Rotenone-bearing Dusts.**—*J. econ. Ent.* **37** no. 2 pp. 242–245, 11 refs. Menasha, Wis., 1944.

In view of the continued shortage of rotenone-bearing roots and pyrethrum, tests with dusts containing cryolite were carried out in Connecticut in 1943 to determine the concentration required to equal the degree of control given by commonly used concentrations of rotenone in derris dust, to test the effect of diluents used with cryolite, and to compare the toxicities of the natural and synthetic forms. Dusts containing 6·25, 12·5, 25 and 50 per cent. cryolite gave varying control of larvae of the Mexican bean beetle [*Epilachna varivestis*, Muls.] on beans planted early in July and dusted on 4th and 16th August, but the most concentrated was no more effective than a derris dust containing 0·25 per cent. rotenone. At the highest concentration, natural cryolite was more effective in clay than in pyrophyllite, but at the others the pyrophyllite diluent produced the higher mortalities. It was the only diluent used with synthetic cryolite. Both natural and synthetic cryolite were effective, but the results were too variable for comparison.

When the same concentrations of cryolite in pyrophyllite were applied on 18th and 31st August and 20th September to late cabbage planted in July for the control of imported cabbage worms [*Pieris rapae*, L.] and cabbage loopers [*Plusia brassicae*, Ril.], cryolite at a concentration of 12·5 per cent. was more effective than a dust of derris and pyrophyllite containing 0·5 per cent. rotenone. The long intervals between treatments and that between the last treatment and the date of assessing results favoured cryolite rather than derris. There was considerable variation between synthetic and natural cryolite; the synthetic compound appeared superior at high concentrations and the natural one at low ones.

Dusts of 6·25, 12·5, 25 and 50 per cent. natural cryolite in clay and of derris and clay (0·25, 0·5, 1 and 2 per cent. rotenone) gave variable control of potato flea-beetles [*Epitrix cucumeris*, Harr.] on potato when applied on 2nd, 4th, 8th, 14th, 21st and 28th June, the second treatment being a replacement of the first, which was followed by rain, but cryolite at the three highest concentrations gave only slightly less control than rotenone at 0·5 and 1 per cent. This schedule tended to favour the derris dust. The potatoes were also heavily infested with the European corn borer [*Pyrausta nubilalis*, Hb.], and the treatments covered the period of hatching of its eggs. Counting the number of entrance or exit holes of migrating larvae and the broken branches on 20th July indicated that cryolite had given considerable protection, 50 per cent. cryolite being more effective than 1 per cent. rotenone. Since the same treatment also controls the Colorado potato beetle [*Leptinotarsa decemlineata*, Say], it should be of practical value in protecting potatoes from *P. nubilalis*, which is not abundant enough each season to justify special treatment.

PEPPER (B. B.) & FILMER (R. S.). **A low Rotenone Content *Derris malaccensis* Dust effective against certain Vegetable Pests.**—*J. econ. Ent.* **37** no. 2 pp. 248–252, 17 refs. Menasha, Wis., 1944.

Since a considerable quantity of *Derris malaccensis*, containing too little rotenone to be of use except as an agricultural insecticide, was known to be available in the United States, field experiments were carried out in 1943 to compare the insecticidal action of a dust of this product containing a trace of rotenone and 2·94 per cent. total ether extractives [cf. *R.A.E.*, **A** **24** 63; **25** 110] with dusts of *D. elliptica* (0·5 per cent. rotenone), cubé (*Lonchocarpus*

sp.) (0.4 and 0.5 per cent. rotenone) and cubé with Lethane 60 [cf. 32 200] (0.4 per cent. rotenone), all in Pyrax ABB (pyrophyllite). Although only limited tests were made, it proved as effective as the other dusts against *Epilachna varivestis*, Muls., on beans, and *Pieris rapae*, L., and *Plutella maculipennis*, Curt., on cabbage, but rather less effective against *Plusia brassicae*, Ril. On tomato, it gave slightly more reduction of *Macrosiphum solanifolii*, Ashm., seven days after treatment than the *D. elliptica* dust or cubé dust containing 0.4 per cent. rotenone, and later observations showed that plants that were untreated or received less effective treatments were badly stunted throughout the tomato season; the dust containing Lethane, like some other thiocyanate dusts tested, caused distinct yellowing of the foliage for about three weeks, after which the injury disappeared. Against the second generation of *Pyrausta nubilalis*, Hb., on sweet maize, five applications of the *malaccensis* dust at approximately five-day intervals from 7th August were superior to similar applications of cubé dust containing 0.5 per cent. rotenone, but less effective than a mixture of fixed nicotine (Black Leaf 155), talc and sulphur containing 4 per cent. nicotine.

LANGFORD (G. S.), ROTHGEB (R. G.) & CORY (E. N.). **Relation of Planting Dates of Corn and Japanese Beetle Injury.**—*J. econ. Ent.* 37 no. 2 pp. 253–257, 4 figs. Menasha, Wis., 1944.

Both the larvae and the adults of the Japanese beetle [*Popillia japonica*, Newm.] injure maize in Maryland, the larvae by feeding on the roots in spring and autumn and the adults by feeding on the foliage, cutting the silks and preventing pollination, and opening the tips of the husks so that moisture sometimes collects in them and produces conditions favourable to mould. The author reviews conditions encountered in the field and gives information obtained in experimental plots on the loss of grain from silk destruction and mould, both of which have sometimes been quite serious. Experiments were carried out in 1936–43 on the extent of damage in heavily infested areas, varietal resistance and the relation of planting dates to beetle damage; open pollinated varieties and hybrids were used, and early, mid-season and late varieties were represented. It was found that damage may be appreciable, particularly if the maize silks early; during 1938–41, the loss on maize that silked before 10th August varied from 5.5 to 40.6 per cent. The abundance of beetles at the silking date proved to be the important factor, and when it was possible to plant maize so that it silked after the peak of infestation had passed, damage was negligible. It was found, however, that the planting period that would avoid both beetle and frost injury was short, and that there is no certain planting date that will ensure freedom from both types of injury. Under average conditions in Maryland, the peak of infestation is over by 10th August, and planting dates that usually allow long-season, medium-season and short-season maize to silk after this date and yet mature before frost in northern Maryland are suggested. There appears to be a relation between beetle feeding and mouldy grain; there was no evidence that the insect carried the organisms involved, but this is considered possible. Varietal resistance was not proved. The beetles showed a decided preference for some varieties or hybrids, and congregated on the preferred varieties in a series of plantings, but in the absence of preferred varieties and other preferred food, serious damage resulted to varieties that showed resistance when planted in mixed series.

DITMAN (L. P.), CORY (E. N.) & OWENS (H. B.). **Pea Aphid Work in Maryland during 1943.**—*J. econ. Ent.* 37 no. 2 pp. 258–261. Menasha, Wis., 1944.

In further investigations on the control of the pea aphid [*Macrosiphum onobrychidis*, Boy.] on peas in Maryland in 1943 [cf. *R.A.E.*, A 32 347], the

regular spray of 3 lb. derris (4 per cent. rotenone) and 4 oz. sodium lauryl sulphate per 100 U.S. gals. water, applied at 150 U.S. gals. per acre, gave 94 per cent. reduction in Aphid population. A dust containing 1 per cent. rotenone from derris and 1 per cent. sodium lauryl sulphate, which had been stored for a year, gave 63 per cent. reduction when applied at 38 lb. per acre in the morning when the dew was still on the plants, and was more effective than dusts containing 0.5 per cent. rotenone as derris or cubé, even when these contained 2 per cent. nicotine, from Black Leaf 10.

In preliminary tests with concentrated sprays, applied during the late morning and early afternoon, sprays containing nicotine sulphate or pyrethrum extract were less effective than the dust containing 1 per cent. rotenone. All the insecticides were applied under an apron 25 ft. long and dusting was done at 3 m.p.h. and spraying at 4.5 m.p.h.; the apron was probably too short and the speed of the machine too great to give satisfactory results with nicotine.

The acreage of peas grown commercially in the State in 1942 and 1943, the acreage treated, the amounts of insecticide purchased and used, and the degree of control obtained are shown in tables, and it is concluded that instances of failure to control the Aphid with derris dusts or sprays in these years were due to ineffective materials or inefficient methods of application.

LATTA (R.) & JOHNSON (A. C.). **Seasonal Changes in Reaction of coniferous Evergreens to Methyl Bromide Fumigations.**—*J. econ. Ent.* **37** no. 2 pp. 261–263. Menasha, Wis., 1944.

The following is based on the authors' summary. Experiments were carried out in Virginia, Maryland and Delaware to test the tolerance of balled and burlapped coniferous evergreen nursery plants of seven varieties to schedules for fumigation with methyl bromide that fulfil the requirements for certification under the quarantine against the Japanese beetle [*Popillia japonica*, Newm.] in the United States [cf. *R.A.E.*, A **31** 256, etc.]. There was a definite relation between the extent of injury to the plants and the season of year at which they were fumigated in the case of *Juniperus communis hibernica*, *Chamaecyparis pisifera*, *Taxus cuspidata*, *Thuja orientalis* and two varieties of *T. occidentalis*. Plants fumigated during late winter, when they were apparently least active, showed no injury to foliage, even when variations in the technique might have induced it, whereas severe injury resulted when plants were fumigated during late March and April, when they were breaking dormancy. The amount of foliage injury in spring fumigation tests was different for each variety, but the same trend from no injury to severe injury was apparent in these varieties. Colorado spruce (*Picea pungens*) showed severe injury in all tests, but in this species the period of dormancy probably ended before the series of tests was begun. *Taxus cuspidata* and *C. pisifera* were selected for further fumigation experiments carried out between August 1941 and May 1942 at Beltsville, Maryland. In this series, a tolerant period was evident between December and February, preceded and followed by periods during which foliage injury occurred. The period of no injury coincided with the least activity of the plants. Since the period of lowered tolerance in both autumn and spring tests occurred at the normal time of movement of nursery stock, it is believed that the injury to commercial nursery stock from fumigation was due to the relative activity of the plants. It is concluded that fumigation of coniferous evergreens in accordance with the quarantine schedules is inadvisable except where open weather conditions permit their treatment during the period of least activity, or where specific varieties have been tested sufficiently to establish their reaction to fumigation at various seasons of the year.

ANDERSON (L. D.) & WALKER (H. G.). **Tomato Pinworm Control in the Greenhouse.**—*J. econ. Ent.* **37** no. 2 pp. 264–268, 5 refs. Menasha, Wis., 1944.

Since *Keiferia lycopersicella*, Busck, has been an important pest of greenhouse tomatoes at the Virginia Truck Experiment Station for ten years, studies on its control were begun in 1943. In tests in which atomised sprays were applied four times from 8th January, when the plants were 6–8 ins. high, to 29th January, when they were 3–4 ft. high, cryolite at the rate of 2 lb. in 50 U.S. gals. water, alone and with 1 lb. soybean flour, and 2 lb. calcium arsenate in 50 U.S. gals. water caused significant reductions in the number of tunnels with no significant difference between treatments. When applied twice in coarse sprays, on 15th February; when the plants were about a foot tall, and 25th February, NNOP (92.45 per cent. technical mannitan monolaurate, 2 per cent. pyrethrins and 5.55 per cent. pyrethrum extractives) in water (1:200) gave 100 per cent. control, whereas cryolite (2 lb. in 50 U.S. gals.) gave only 21 per cent. NNOP (1:200) was also more effective than NNOR (97.1 per cent. technical mannitan monolaurate, 1 per cent. rotenone and 1.9 per cent. other derris extractives) at the same strength. In tests on egg-plant [*Solanum melongena*], applications of NNOP and NNOR (1:400) on 26th February, when the plants were 6–8 ins. tall, and 15th and 19th March gave practically complete control of *Keiferia* larvae; they also gave good control of *Myzus persicae*, Sulz., and of all stages of *Trialeurodes vaporariorum*, Westw. In another test in which applications were made on 13th and 19th April, when the plants were about 20 ins. tall and were setting fruit, NNOP and Extrax, which contained 2.5 per cent. rotenone, 7.5 per cent. other derris resins, 0.4 per cent. pyrethrins, 32.1 per cent. petroleum oils, 35 per cent. polyglycol esters, 2.5 per cent. pine wood oil acids and 20 per cent. glycol dichloride, gave about 97 per cent. mortality; Red Arrow, which contained 10 per cent. coconut oil soap, 7 per cent. sulphonated coconut oil, 3.75 per cent. petroleum ether extracts of pyrethrum (including 0.9 per cent. pyrethrins), 1.66 per cent. rotenone, 9.5 per cent. fatty acid esters of glycols sulphated, 0.75 per cent. sodium tetradecyl sulphate, 21 per cent. camphor oil and 7 per cent. pine oil, gave 68.5 per cent.; and Evergreen (6 per cent. pyrethrum extractives) gave 58.5 per cent. All these materials were used at 1:400; they gave good control of *M. persicae* and the first two were effective against eggs, nymphs and pupae of *T. vaporariorum*. The plants were not treated for a month, after which *Keiferia* larvae were numerous again, but one application of NNOP (1:400) gave practically complete control.

In tests of the value of pyrethrum and rotenone extracts as contact insecticides in which individual larvae were dipped in a drop of insecticide on the under side of a leaf for about ten seconds, NNOP was much more effective than NNOR or NNORP (technical mannitan monolaurate containing 1 per cent. rotenone and 1 per cent. pyrethrins) at dilutions of 1:800, 1:1,600, 1:3,200 and 1:6,400; technical mannitan monolaurate alone gave practically no kill at the three lowest concentrations. NNOP and Extrax were about equally effective at most dilutions and Red Arrow was slightly less so; Evergreen was as effective as NNOP and Extrax at 1:800 and 1:1,600, but less effective at 1:3,200. When drops of insecticide were put on the eggs in their natural positions on the leaves and wiped off after for 4–5 seconds, both NNOP and NNOR killed all the eggs at 1:800, 1:1,600 and 1:3,200, but very few at 1:6,400 and 1:12,800; eggs treated with water hatched normally. When sprayed on to egg-plant foliage, NNOP, Extrax and Red Arrow gave complete kills of eggs at 1:400, whereas Evergreen killed very few. Dipping infested seedlings of tomato and egg-plant in NNOP or NNOR (1:200) for approximately 15 seconds gave almost complete control. In all tests in which infested foliage was treated, practically all the dead larvae were found within their tunnels.

These materials were not tested against *K. lycopersicella* in the field, but in one small test on *Gnorimoschema operculella*, Zell., mining in potato foliage, NNOP killed 19 and NNORP 20 of 30 larvae.

EWART (W. H.), WATKINS (T. C.) & ASHDOWN (D.). **Insecticidal Uses of Tartar Emetic : against Onion Thrips in New York.**—*J. econ. Ent.* **37** no. 2 pp. 269–276, 39 refs. Menasha, Wis., 1944.

The authors review the literature on the use of tartar emetic in sprays against insects and give an account of experiments carried out in the greenhouse and in the field in 1939–44 on the control of *Thrips tabaci*, Lind., on onion in New York. The following is based on their summary. Tartar emetic proved satisfactory in sprays against the onion thrips, but in many instances, insect populations were so low that reductions in numbers due to spraying did not result in corresponding increases in onion yields. Various phases of the problem need further investigation, but it would seem advisable to make five or six applications of a spray of 2 lb. tartar emetic, and 4 lb. sugar per 100 U.S. gals. water at about six-day intervals, beginning early in the season when the onions are 4–6 ins. high. The spray should be applied at the rate of at least 125 U.S. gals. per acre and at a pressure of 150 lb. The use of wetters or spreaders does not seem justified, but other insecticides such as sodium antimonyl lactophenolate or sodium antimonyl hydroxyacetate in sprays with sugar and a pyrethrum dust seemed to offer definite possibilities.

The recommended spray schedule is a matter of insurance based on the residual effect of the spray, as applications are made before the thrips have reached injurious numbers. It affords a considerable advantage, as it permits the conclusion of spraying operations before the onions have attained sufficient growth to be severely damaged by the sprayer. In some years, thrips populations do not attain high levels in New York because of natural factors, but, in view of the cheapness of the materials, the increased value of onions in years when damage is severe and the normally high value of particular crops, such as those grown for seed, such a spray programme would seem to be economically sound.

BAKER (E. W.). **Studies on the Response of Fruitflies to Temperature.**—*J. econ. Ent.* **37** no. 2 pp. 280–283, 6 graphs, 3 refs. Menasha, Wis., 1944.

Anastrepha ludens, Lw., which is apparently indigenous to the north-eastern part of Mexico, where the larvae are found in *Sargentia greggii*, a wild native fruit of the same family as *Citrus*, is a serious pest of *Citrus* and mango in that country and has also recently become important in the Rio Grande Valley of Texas. *A. serpentina*, Wied., which occurs as far south as Brazil, but has recently become numerous in Texas, commonly attacks *Calocarpum mammosum*, *Achras sapota* and *Chrysophyllum cainito*, but has been found in orange and grapefruit. A third species, which is called Mexican *A. mombinpraeoptans* in this paper, but is said to differ in habits and structure from the true *A. mombinpraeoptans*, Seín, of Porto Rico, attacks jobo [*Spondias*] in Morelos and *Eugenia jambos* and *S. mombin* in the vicinity of Cordoba, Vera Cruz; it is rarely found in mango in Morelos, whereas the Porto Rican species is an important pest of this fruit, but another form, also called *A. mombinpraeoptans*, that has not been studied, attacks mango near the City of Vera Cruz. The insect dealt with here readily infested California plums in the laboratory and oviposited in guavas, though no larval development was noted in the latter.

Tests are described in which 50 newly emerged adults of each sex were caged and kept at constant temperatures to discover how long they would live. For *A. ludens*, the greatest median survival time (254 days) occurred at 15°C. [59°F.] and the maximum oviposition (1,492 eggs per cage) at 25°C. [77°F.]; for *A. serpentina*, median survival was longest (140 days) at 20°C. [68°F.] and oviposition greatest (1,484 eggs) at 30°C. [86°F.]; and for Mexican *A. mombinpraeoptans*, median survival was longest (59 days) at 20°C. and oviposition greatest (111 eggs) at 25°C. In the laboratory, *A. ludens* showed the longest developmental period and Mexican *A. mombinpraeoptans* the shortest.

These studies substantiate field observations in Morelos ; at an elevation of 4,750 ft., mangos were heavily infested with *A. ludens* and jobos only lightly infested with Mexican *A. mombinpraeoptans*, whereas at 3,750 ft., where it was warmer, mangos were only moderately infested with *A. ludens* and jobos were heavily attacked by Mexican *A. mombinpraeoptans*.

FROST (S. W.), DILLS (L. E.) & NICHOLAS (J. E.). **The Effects of Infrared Radiation on certain Insects.**—*J. econ. Ent.* **37** no. 2 pp. 287–290, 3 graphs, 10 refs. Menasha, Wis., 1944.

Experiments are described in which a number of insects were exposed to radiation from a 362-watt lamp for varying periods to determine the lethal exposure to infra-red rays and the cause of death from such exposure ; the insects were put in petri dishes with an infra-red filter on top, five inches from the end of the bulb, where the energy distribution was found to be 50–57 micro-watts per sq. cm. All larvae and adults of *Tribolium confusum*, Duv., were killed in 30 seconds, and 60 per cent. in 15 ; there seemed to be little difference between the resistance of the larvae and the adults. There was a marked difference in resistance between larvae and adults of *Tenebrio molitor*, L., the exposures required for 100 per cent. mortality being 14 and 9 seconds, respectively, possibly because the darker colour of the adults absorbed heat more rapidly and their more heavily sclerotised body-wall retained the absorbed energy better. Adults of *Bruchus (Acanthoscelides) obtectus*, Say, and *Attagenus piceus*, Ol., were all killed by exposure for 30 seconds, and exposure for 12 and 14 seconds gave 83 and 89 per cent. kill of eggs of *Oncopeltus fasciatus*, Dall. Since there was a marked increase in the internal temperature of the insects exposed to infra-red rays for the minimum period necessary to produce death, it appears that this is the cause of death. When the filter rested on the petri dish, the temperature was slightly higher inside than in the open ; when the filter was an inch above the dish, the time required to kill larvae of *T. molitor* was increased to 18 seconds.

A few preliminary tests showed that no kill was obtained when adults of *Tribolium confusum* were covered with a quarter of an inch of wheat flour and exposed to infra-red radiation for one minute at a distance of five inches from the source.

WILFORD (B. H.) & MOTT (L. O.). **Results of Tests with domestic Animals confined on Pastures sprayed with natural Cryolite.**—*J. econ. Ent.* **37** no. 2 p. 291. Menasha, Wis., 1944.

As there have been conflicting statements regarding the toxic effect on domestic animals of cryolite, which was substituted for lead arsenate in the Federal spraying programmes for the control of the gypsy moth [*Lymantria dispar*, L.] and white-fringed beetles [species of the subgenus *Graphognathus* of *Pantomorus*] in the United States during 1943, tests were carried out during the summer in which horses, cattle, sheep and goats were allowed to graze for considerable periods in paddocks that had been sprayed with natural cryolite at the rate of 40 lb. per acre. From the results obtained it appeared that the residues on the forage were not injurious to them.

PARKER (R. L.). **Control of the Common Red Spider.**—*J. econ. Ent.* **37** no. 2 p. 292, 1 ref. Menasha, Wis., 1944.

In Kansas greenhouses, DN-111 [20 per cent. of a dicyclohexylamine salt of 2, 4-dinitro-6-cyclohexylphenol], used at the rate of $\frac{1}{2}$ –1 lb. per 100 U.S. gals.

water, was found to be more effective against *Tetranychus telarius*, L., than Emulsifier B-1956 Spreader [phthalic glyceryl alkyd resin] [cf. *R.A.E.*, A 29 535]. It did not scorch lucerne, wheat, oats, barley, maize or sorghum plants at either concentration, and the two appeared to give practically equal control. The lower concentration controlled the mite and its eggs on peach and lima bean within four days and did not injure the foliage. Only one application of insecticide per plant was made. To protect greenhouse plants against *T. telarius*, it is recommended that a concentration of $\frac{1}{8}$ – $\frac{1}{4}$ lb. DN-111 per 100 U.S. gals. water should be applied to the point of dripping to all parts of the plants and both sides of the leaves at regular intervals of 4–6 weeks; more spray pressure should be exerted for proper penetration where the leaves have a heavy pubescence.

BOWEN (C. V.). **Insecticidal Possibilities of *Duboisia hopwoodii*.**—*J. econ. Ent.* 37 no. 2 p. 293, 6 refs. Menasha, Wis., 1944.

A shipment of *Duboisia hopwoodii*, which is known to contain nornicotine, was recently received in the United States from Australia. Tests of samples of leaves, leaves on twigs, twigs without leaves, and larger stems showed that their nornicotine contents were 3.31, 1.92, 0.95 and 0.52 per cent., respectively. No other alkaloid was present in them. Since all the nornicotines seem more toxic than natural nicotine to *Aphis rumicis*, L. [cf. *R.A.E.*, A 29 353], it is considered that wild plant material with an alkaloid content such as this should be exploited as a source of insecticides. It is to be expected that a higher alkaloid content would result from pruning, fertilising, the removal of flowers and other cultivation practices.

CHAMBERLIN (F. S.). **Control of the Vegetable Weevil in Tobacco Plant Beds.**—*J. econ. Ent.* 37 no. 2 pp. 293–294, 1 ref. Menasha, Wis., 1944.

Since 1937 [cf. *R.A.E.*, A 26 144], *Listroderes obliquus*, Gylh., has become an important pest of tobacco seedlings in plant beds in the area in which cigar tobacco is produced in Florida and Georgia. In the absence of control measures the larvae cause serious damage to seedlings and are carried on them into the field where they continue to be injurious. In preliminary experiments in Florida in 1938 and 1939, lead arsenate gave satisfactory control, but materials containing rotenone were much less effective. In further tests made in infested plant beds in 1940–43, three or four applications of sprays of 2, 3 or 6 lb. lead arsenate per 100 U.S. gals. water usually gave satisfactory control, but the highest concentration caused some scorching of the foliage, and four applications of dusts of lead arsenate and tobacco dust (5 : 5) or synthetic cryolite and tobacco dust (8 : 2) were also effective. From these results and observations on commercial spraying and dusting, it is concluded that a spray of 2–3 lb. lead arsenate per 100 U.S. gals., applied at the rate of 3 U.S. gals. spray per 100 sq. yards, or a mixture of equal parts of lead arsenate and tobacco dust, applied at the rate of 8 oz. per 100 sq. yards, will give satisfactory control; 3–4 applications at intervals of a week during the latter part of the growing season are required to control relatively heavy infestations in the plant bed, but 1–2 are usually sufficient against light infestations.

Experiments and commercial practice indicate that lead arsenate may be incorporated in sprays containing copper oxide, vegetable oils and a phthalic glycerol alkyl resin spreader, applied against blue mould (*Peronospora tabacina*), and that combination sprays and dusts containing a commercially prepared ferric dimethyl dithiocarbamate and the arsenical may also be applied to the seedlings with apparent safety.

LATHROP (F. H.), PLUMMER (B. E.) & DIRKS (C. O.). **A simplified Method of sampling known Areas of Apple Leaves for chemical Analysis.**—*J. econ. Ent.* **37** no. 2 pp. 294-295, 1 fig. Menasha, Wis., 1944.

The authors describe an apparatus consisting of two octagonal pieces of flat sheet metal, between which five apple leaves bearing spray deposits can be held so that they can be cut into shape round the larger one to provide samples of a known area. This provides a rapid method of sampling, and when a hundred sections are used to a sample, the leaf areas are large enough to permit the analysis for arsenic to be made by the bromate method for ordinary spray deposits. The samples proved to be statistically reliable.

MUMA (M. H.), LANGFORD (G. S.) & CORY (E. N.). **Mineral Oils as Diluents of the Geraniol-eugenol Japanese Beetle Bait.**—*J. econ. Ent.* **37** no. 2 pp. 295-297, 5 refs. Menasha, Wis., 1944.

Data obtained in Maryland during 1943 indicate that an efficient bait for the Japanese beetle [*Popillia japonica*, Newm.] may be obtained by diluting with white mineral oils the mixture of geraniol and eugenol now used [*cf. R.A.E.*, A **31** 488]. The standard bait for the tests was a mixture of 9 parts geraniol and 1 part eugenol and it was combined in ratios varying from 1 : 9 to 9 : 1 with a mixture of equal quantities of light white mineral oil (viscosity 125-135 secs. Saybolt) and diobase oil, which had nearly the same evaporation rate. Traps containing 30 cc. diluted or undiluted bait were arranged in lines with an empty trap in each line and at least one standard for every fourth trap; the bait was allowed to evaporate through half-inch cotton wicks and replenished when no liquid other than that contained in the wick was visible. Beetle counts and trap rotations were made daily.

The seasonal catches of diluted baits increased from an average of 5,829 beetles for the mixture that contained 90 per cent. diluent to 12,128 for that containing 40 per cent., the progressive increase in attractiveness being significant but not proportional to the amount of diluent. At higher concentrations, the total catches of the baits varied slightly, but remained well within the variation of the undiluted bait, which ranged from 11,829 to 13,137 per season. A mixture of equal quantities of standard and diluent seemed to make an effective bait, averaging 11,497 beetles, and, in another test late in the season, four traps containing it caught an average of 233 beetles in 14 days as compared with 226 for four traps of the standard bait. Empty traps averaged 431 beetles in the main experiment, as compared with 679 for the diluent alone, indicating that no great increase in the attractiveness of the baits could be attributed to the latter.

STONE (M. W.). **Dichloropropane-Dichloropropylene, a new Soil Fumigant for Wireworms.**—*J. econ. Ent.* **37** no. 2 pp. 297-299, 1 ref. Menasha, Wis., 1944.

A crude mixture of 1, 2-dichloropropane and 1, 3-dichloropropylene [*cf. R.A.E.*, A **31** 360] with an oil-soluble emulsifier (96 : 4) was tested against *Limonius californicus*, Mannh., in a small series of laboratory and field experiments in California. In preliminary tests with wireworms two and three years old, concentrations of 0.25, 0.5, 0.75 and 1 cc. per U.S. gal. water, applied at the rate of 1 U.S. quart per 8-inch pot, killed 40, 93.1, 98.3 and 98.2 per cent., respectively, within five days, and the highest concentration, applied at the same rate, killed 38.9, 66.2, 80.8, 91.1 and 96.7 per cent. in 16, 24, 36, 48 and 72 hours, respectively; the average mortality in untreated pots was 2.5 per cent. The soil temperatures in the two tests were 58-74° and 42-66°F., respectively, and the moisture content of the soil before treatment was 12-14 per cent.

by weight in both. Siftings of soil samples four days after treatment showed that the application of 1.5 cc. in 1 U.S. gal. water per foot of row to beans planted in a trench of sandy loam soil killed 95 per cent. of the wireworms attracted to the plants. An average of 1.5 wireworms per foot of row was recovered in the treated rows, as compared with an average of 1.6 in a row treated with water only, indicating that the mixture had no repellent effect. The wireworms were of various ages and sizes and the moisture content of the soil before treatment was 12-16 per cent. by weight.

In field tests in packed, moist sandy loam soil, 29.57 cc. (1 U.S. fl. oz.) of the mixture or of carbon bisulphide was injected at a depth of 1 in. at each corner of areas ranging from 12 to 24 ins. square, with cages containing wireworms and soil buried vertically in holes 17 ins. deep in the middle. Examination five days after treatment showed that the mixture had killed all the wireworms to a depth of 17 ins. within lateral distances of 8.5-15.5 ins. from the point of injection, whereas carbon bisulphide gave complete kill only within lateral distances of 8.5-11.25 ins. In another field test in which wire-screen cages containing wireworms and soil were placed horizontally at depths of 8, 12 and 16 ins. in a plot of ploughed sandy loam, which was then sprayed with 1.25 U.S. gals. water containing 1.25 cc. of the mixture per sq. ft., only 30 and 32 per cent. at depths of 8 and 12 ins. and none at a depth of 16 ins. had been killed five days after treatment, and only a slight odour of the mixture could be detected at the greater depths. When similar cages were buried horizontally 4, 8, 12 and 16 ins. deep in plots that were then sprayed with 1.25 and 1.5 cc. of the mixture per U.S. gal. water, applied at 2.25 and 2 U.S. gals. per sq. ft., respectively, or with water at 2.1 U.S. gals. per sq. ft., only dead wireworms were found in the cages or soil of plots treated with the mixture, but only 3.3 per cent. of the wireworms in cages and none of those in the soil of the watered plot were dead. The moisture content of the soil before treatment was 14-16 per cent. in the last two tests. To ascertain the effect of the mixture on plant growth, this soil was ploughed and disked and planted with lima beans, maize, peas, yams and tomatoes six days after treatment. The seedlings of the first three appeared on the same day and in approximately the same numbers as corresponding plants on untreated plots and showed no difference in size, appearance or number after 12 days, and neither the tomatoes nor the yams appeared to be affected by the treatment.

SWEETMAN (H. L.) & BOURNE (A. I.). Toxicity of natural and synthetic Cryolites to Rats.—*J. econ. Ent.* **37** no. 2 pp. 299-300, 6 refs. Menasha, Wis., 1944.

In tests with rats of various ages and sizes, a paste of cryolite powder and water was injected into the stomach by the mouth. Rats that received up to 2 gm. synthetic cryolite or up to 33.6 gm. natural cryolite per kg. body weight (the highest dosages tested) appeared to be normal and showed no acute injury of any kind, whereas others that received 0.375 and 0.4 gm. sodium fluosilicate per kg. died in 3 and 32 hours, respectively. One treated with 0.275 gm. sodium fluosilicate per kg. was ill for three days but recovered, and one put in a cage with the floor covered with a heavy layer of sodium fluosilicate dust was killed in about 36 hours.

YOTHERS (M. A.) & CARLSON (F. W.). A graphic Method of indicating the Incidence of an Insect Population.—*J. econ. Ent.* **37** no. 2 pp. 300-301, 2 figs. Menasha, Wis., 1944.

The authors describe a graphic method that was used to indicate the differences in abundance of the codling moth [*Cydia pomonella*, L.] in different parts of a given area in the course of studying the data from experiments in

Washington on the scraping and banding of apple trees for its control. It indicates the occurrence of population in each unit area and not the degree of infestation.

The numbers of larvae caught in each square of 16 trees or tree spaces were added together, regardless of variety, yield, infestation, tree size or absence of trees, and a model of wooden blocks was built to scale, each block representing a 16-tree area and each centimetre of height 100 larvae. Illustrations of the models constructed in 1940 and 1941 are given, and the distribution of population incidence as shown by them is discussed.

IVY (E. E.). **Dusting Device for Toxicity Experiments on Field grown Plants.**—*J. econ. Ent.* **37** no. 2 p. 301, 1 fig. Menasha, Wis., 1944.

In the course of field-cage toxicity experiments carried out in Texas to test insecticides against *Heliothis armigera*, Hb., *Anthonomus grandis*, Boh., and *Alabama argillacea*, Hb., on cotton, a dusting chamber and dusting device with which a definite amount of dust calculated on a per acre basis could be applied uniformly to a plant were developed. The apparatus and the method of using it are described.

ROARK (R. C.). **"Incompatability" of Insecticides.**—*J. econ. Ent.* **37** no. 2 p. 302, 3 refs. Menasha, Wis., 1944.

The author points out that the incompatability of two materials may be physical, when they will not mix, chemical, when they react when mixed, or physiological, when they have opposite or antagonistic effects on an organism, but that these distinctions have rarely been observed by writers on insecticides or fungicides. He gives examples of contradictory instructions that have resulted from the employment of the term compatible to designate mixtures that produce a desired result in the case of particular insects on particular plants irrespective of physical repellence or chemical interaction between the ingredients and suggests that its use in connection with insecticides and fungicides should be abandoned as too indefinite and that charts drawn up for guidance in mixing them should designate the mixtures as suitable or unsuitable with specific reference to the pest and plant under consideration and the region in which the crop is grown.

DECKER (G. C.). **Substitutes for Creosote in Chinch Bug Barrier Construction.**—*J. econ. Ent.* **37** no. 2 pp. 303-305. Menasha, Wis., 1944.

Tests in which coal-tar creosotes and possible substitutes for use as barriers to the chinch bug [*Blissus leucopterus*, Say] were applied in lines on smooth tamped soil between grain and maize fields where heavy natural migration was in progress were carried out in Iowa in 1942, preliminary tests in 1940-41 having given promising results with certain fractions of wood creosote and lignite creosote. The numbers of bugs crossing 10-ft. lines of the barriers per minute, 2, 6, 24 and 48 hours after their application, and a rating of their efficiency based on estimates by several observers are given in tables. There was a considerable difference in the performance of coal-tar creosote from different sources. Lignite creosote and all the wood and coal-tar creosotes tested were definitely better than pine tar, water-gas tar, naphthalene drain oil, road oil and crank case oil. Three of the eight samples of wood creosotes were good and three poor, but their degree of effectiveness could not be correlated with any of the physical properties given in the usual specifications, apparently depending on the chemical composition of the oil. It is therefore impossible to write specifications for wood creosotes to use for chinch-bug barriers. Chlor-2-phenylphenol in fuel oil (20 : 80) appeared to be a better barrier than the best

creosote, but the difference was not significant. The highly volatile naphthalene drain oil was very effective when fresh, but less so after 6 or 24 hours. Weather conditions had an important effect on the tests of any particular day; heavy viscous oils were better on cool days, particularly when they were applied on moist soil, but became glazed or crusted, and therefore completely worthless, in a few hours when applied on hot, dry, dusty days.

DONOHUE (H. C.). **Chloropicrin Treatment of bulk potting Soil for Japanese Beetle Control.**—*J. econ. Ent.* **37** no. 2 p. 305. Menasha, Wis., 1944.

Chloropicrin is extensively employed for the reduction of weeds and certain soil micro-organisms in bulk potting soil. For this purpose, a given quantity is injected to a depth of 2–6 ins. in the centre of each square foot of surface in a layer of moist screened or shredded soil 1 ft. deep, the quantity is doubled round the bin edges, and the surface of the soil is wet to a depth of 1–2 ins. immediately after treatment and covered with canvas or paper for 5–10 days. In three tests carried out with 1-ft. depths of moist screened soil in bins to determine the applicability of the method to disinfestation treatments in compliance with quarantine regulations against the Japanese beetle [*Popillia japonica*, Newm.] in the United States, all the larvae were dead when examined one day after their removal from the treated soil. In the first test, caged larvae were introduced 30 hours after treatment with 3.5 ml. per sq. ft. of surface at 68°F. and removed 17 hours later; in the second, the larvae were put in the soil before treatment with the same dosage at 57°F. and removed 18 hours and 5 days later; and in the third, the larvae were put in soil before treatment with 4.5 ml. per sq. ft. at 50°F. and removed five days later. The mortalities in untreated soil were 0, 2.3 and 4.8 per cent., respectively. In the first two tests, the soil was watered after treatment and in the second it was covered with canvas; in the third the surface was not watered, but was covered partly with canvas and partly with several thicknesses of newspaper. It is concluded that chloropicrin as applied for weed control is suitable for use in destroying the larvae of *P. japonica* in bulk binned potting soil.

CHAPMAN (P. J.), AVENS (A. W.) & PEARCE (G. W.). **San Jose Scale Control Experiments.**—*J. econ. Ent.* **37** no. 2 pp. 305–307, 2 refs. Menasha, Wis., 1944.

Tests carried out in New York in 1943 with oil emulsions applied to fruit trees at the delayed dormant stage showed that paraffinic-type oils were more efficient against the San José scale [*Quadraspidiotus perniciosus*, Comst.] than those derived from an asphalt base and classified as being naphthenic in character, but this difference in toxicity was not apparent unless the oil concentration was reduced below 1 per cent. Where the oil is used at 2–3 per cent., a high rate of kill may be expected with almost any of the oils that are used in dormant sprays, but these results suggest that by using a paraffinic-type oil it may be possible to reduce the oil concentration to 1 per cent. in this area, provided that the emulsifier used equals or exceeds Bordeaux mixture or blood albumin (2 oz. per 100 U.S. gals. spray) in oil deposition rate.

Sprays of 4, 6-dinitro-o-cresol [numbered with OH as 1] in water made acid or alkaline with 5 oz. oxalic acid or 8 oz. hydrated lime per 100 U.S. gals. and of sodium dinitro-o-cresylate (Elgetol) in water were relatively ineffective against *Q. perniciosus* when used at rates corresponding to 3.2–20.7 oz. dinitro-cresol per 100 U.S. gals. The solubility of the dinitro-cresol in distilled water at 20°C. [68°F.] is approximately 0.03 per cent., but larger amounts dissolve in practice, depending on the pH, hardness, temperature and other characteristics of the water, and it is probable that all of it was in solution at the concentrations tested in these experiments where Elgetol was used and where lime was added to the dinitro-cresol powder in the spray tank.

WALKER (H. G.) & ANDERSON (L. D.). **Tomato Hornworm Control.**—*J. econ. Ent.* **37** no. 2 p. 308, 2 refs. Menasha, Wis., 1944.

Investigations were carried out in Tidewater, Virginia, in August 1943 to compare the effectiveness of several dusts against *Protoparce sexta*, Joh., and *P. quinquemaculata*, Haw., in a heavily infested tomato field. General observations at the end of 24 hours indicated that calcium arsenate killed the larvae more quickly than any of the other dusts tested, but the percentages dead 72 hours after treatment were 88.6 for Krytox (a mixture of 80 per cent. cryolite and 20 per cent. sulphur) applied at 48 lb. per acre, 87.4 for cryolite at 31 lb., 87.1 for calcium arsenate at 44 lb., and 71.9 for a mixture of calcium arsenate, Paris green and hydrated lime (4 : 1 : 5) at 44 lb. The total numbers of larvae were lower on untreated plants and those dusted with 48 lb. phthalonitrile (25 per cent.) per acre, because most of these were nearly defoliated by the time the counts were made and many larvae had left the plants to pupate or in search of other food ; 8.7 and 37.6 per cent., respectively, were dead on these plants. Practically all the living larvae on the plants treated with Krytox, cryolite or calcium arsenate were found on parts that were not well covered with dust, but many on those treated with phthalonitrile were still feeding on parts that had been heavily dusted.

FLANDERS (S. E.). **Control of the Long-tailed Mealybug on Avocados by Hymenopterous Parasites.**—*J. econ. Ent.* **37** no. 2 pp. 308-309, 1 ref. Menasha, Wis., 1944.

Before 1942, *Pseudococcus adonidum*, L. (*longispinus*, Targ.) was one of the most serious pests of avocado in San Diego County, California, and a survey of infested orchards near Carlsbad in 1939 revealed a heavy population, accompanied by a black condition of the foliage resulting from the growth of sooty-mould on the mealybug excrement, with only slight parasitism by *Coccophagus gurneyi*, Comp., and none by *Tetracnemus peregrinus*, Comp., or *Anarhopus sydneyensis*, Timb., which had been liberated five years earlier on *Dracaena* 30 miles to the south-west and on *Citrus* 70 miles to the north [cf. *R.A.E.*, A **29** 297, 298]. *Anarhopus* was well established on *Citrus* and *Tetracnemus* on *Dracaena* at the points of liberation, but their spread had probably been retarded by wide host-free areas. In the spring of 1941, sufficient parasitised material was collected to establish both species in the Carlsbad area, and mealybugs parasitised by both were recovered in December. A year and a half after this liberation, it was difficult to find an unparasitised mealybug in avocado orchards, and by December 1943, the parasites were controlling the mealybug so well that it was doing little or no commercial damage to avocado trees in orchards that had been heavily infested for years previously.

Cryptolaemus montrouzieri, Muls., had previously been liberated, but this Coccinellid is incapable of giving satisfactory control of a mealybug that does not produce egg masses. The top-working of avocado trees is greatly facilitated by the introduction of the parasites ; the paper sacks put over the grafts to protect them from sun and wind afford a perfect habitat for the mealybug, and *Cryptolaemus* larvae do not enter them, but *Tetracnemus* and *Anarhopus* effectively control the mealybugs on the grafts, particularly when the sacks are perforated so that the parasites can move freely in and out.

PARKER (J. R.) & SCHWEIS (G. G.). **Toxicity of Sodium Fluosilicate to Livestock, Poultry, and Game.**—*J. econ. Ent.* **37** no. 2 pp. 309-310. Menasha, Wis., 1944.

The results of experiments carried out by H. Welch in Montana and by E. Records in Nevada during 1939-41 to determine the toxicity of sodium fluosilicate to livestock, poultry and game are given and discussed. They indicate that a bait containing 4 lb. sodium fluosilicate per 100 lb. bran, as used for the Mormon

cricket [*Anabrus simplex*, Hald.] is extremely distasteful to sheep, horses, cows and rabbits and is not readily eaten by fowls, ducks, quail or pheasants. In no instance was enough bait eaten voluntarily to cause any ill effects. Forced feeding of sheep showed that 36.4 gm. sodium fluosilicate, or about the quantity contained in 2 lb. bait, was sufficient to cause death. One sheep was given 18.2 gm. sodium fluosilicate and remained normal. A sheep that ate wet grasshopper bait containing 4 oz. bran and 4.75 cc. sodium arsenite solution (32 per cent. arsenious oxide) died in 13 hours, but another that received 2.37 cc. sodium arsenite solution through a stomach tube survived. This indicates that grasshopper bait containing liquid sodium arsenite is approximately eight times as toxic to sheep as similar bait containing sodium fluosilicate.

WALTON (R. R.) & WHITEHEAD (F. E.). **Effects of Nicotine Dust on the Melon Aphid and its natural Enemies.**—*J. econ. Ent.* **37** no. 2 pp. 310-311. Menasha, Wis., 1944.

Plot tests were carried out in Oklahoma in July and August 1942, with dusts of nicotine sulphate and hydrated lime, applied at approximately 20 lb. per acre, against the melon aphid [*Aphis gossypii*, Glov.] on cantaloupes. The use of aprons on the dusting machine caused no significant increase in control when there was no wind, but when the wind was strong enough to carry the dust fog out of the field, the average percentage decrease in Aphid infestation was 66 when no apron was used, 76 with an apron 30 ft. long and 81 with one 60 ft. long, while the untreated plots showed an average increase of 7 per cent. Although the 60-ft. apron was significantly the better, the shorter one appeared to be more practical as it was less expensive and more easily handled. When applied with a 60-ft. apron, dusts containing 1, 2, 3 and 4 per cent. nicotine caused 45, 71, 80 and 81 per cent. decrease in infestation; the untreated plots showed an average increase of 26 per cent. Results from the two lowest concentrations varied widely, but the weakest dust was not sufficiently effective for practical use. The two highest concentrations were significantly the most effective, and the lower cost and better dusting quality of the dust containing 3 per cent. nicotine made it more practical than the one containing 4 per cent.

Counts were made of the percentages of curled leaves harbouring natural enemies of the Aphid just before dusting and three days later, and the figures were 14.1 and 15.3 for Syrphid larvae, 6.6 and 6.1 for Coccinellid larvae and adults, 3.8 and 4 for larvae of aphid lions [Chrysopids], and 12.7 and 14.6 for Aphids parasitised by *Lysiphlebus*. The corresponding figures for untreated plots were 13.7 and 13.4, 3.8 and 4.2, 3.2 and 4.6, and 9 and 10. Since the dusts thus killed high percentages of Aphids and had little effect on their enemies, treatment brought about distinct changes in the ratio of natural enemies and Aphids, and this probably accounted for the excellent control [*cf.* R.A.E., A **32** 333] that was obtained in most of the fields, including some in which the dusting was only moderately effective. Where entire fields were treated there was a sudden drop in the Aphid population immediately after dusting and a gradual decline of the remaining population until practically no Aphids were left, but where only a small portion of a field was treated the Aphids began to increase again after the decrease due to dusting and were soon present in injurious numbers. It appeared that in the former case the natural enemies destroyed the Aphids faster than they were able to reproduce, but that in the latter the Aphids over the field as a whole still reproduced faster than their enemies destroyed them, so that dusted plots soon became reinfested.

DICKINSON (B. C.). **Technique for studying the residual Value of organic Insecticides.**—*J. econ. Ent.* **37** no. 2 pp. 311-312. Menasha, Wis., 1944.

The author considers that testing the residual value of organic compounds is one of the most important parts of investigations on their use as insecticides

and describes the technique of such a test. *Tetranychus bimaculatus*, Harvey, is used for the test because of its short life-history and the ease with which a stock is reared. Lima beans in pots are sprayed with known amounts of the insecticide per unit area and infested with five adult mites per leaf at various intervals afterwards. Only the primary leaves are used, and the mites are confined to a definite area with a sticky barrier. The mites are removed from the plant after 48 hours, when mortality records are taken, and five days later, when all the eggs deposited will have hatched if the insecticide has had no inhibitory action, records are made of the number of eggs deposited, the number hatched, the number of nymphs that had survived the first moult and any evidence of phytotoxicity. All these results are important, and it is unlikely that they would be revealed in the usual direct contact or gross feeding test.

FLANDERS (S. E.). **Biological Control of the Potato Mealybug.**—*J. econ. Ent.* **37** no. 2 p. 312, 2 refs. Menasha, Wis., 1944.

Phenacoccus solani, Ferris, infests sprouting potatoes in the insectary in California and seriously interferes with the propagation of other Coccids on them, but *Acerophagus pallidus*, Timb., has been used with success for its control in recent years when the Coccid being reared has been the black scale [*Saissetia oleae*, Bern.]. Periodic liberations of the parasite are necessary, as some of the mealybugs are beneath the soil, where they escape its attack and are a source of reinfestation. It cannot be used, however, when the Coccid being propagated is *Pseudococcus maritimus*, Ehrh., since it oviposits readily in the latter, which is an unsuitable host, and its rate of reproduction is therefore reduced. Although its oviposition in *P. maritimus* is abortive, it is lethal if frequent enough and so also prevents propagation of the mealybug for all practical purposes. *A. pallidus* develops in all the post-embryonic stages of *Phenacoccus solani* [cf. R.A.E., A **23** 527], singly in very small individuals and gregariously in larger ones; at about 80°F. the life-cycle is completed in 17 days.

In June 1943, several thousand examples of *A. pallidus* were shipped to Hawaii.

CHAMBERLIN (T. R.). **Observations on Nematodes associated with White Grubs.**—*J. econ. Ent.* **37** no. 2 pp. 313–314, 2 refs. Menasha, Wis., 1944.

Attempts were made in Wisconsin to infest larvae of *Lachnosterna* (*Phyllophaga*) spp. with *Neoapectana glaseri* and an undetermined species of *Neoapectana*, which were known to be parasites of *Popillia japonica*, Newm. These Nematodes were introduced into field cages containing larvae in the first, second and third instars and into tins of soil containing single larvae. Neither species was recovered from the larvae, but other Nematodes were found in them and in control larvae. Subsequently *Lachnosterna* larvae were collected from many places in the field and kept in the original soil, and almost without exception these were found to be infested with Nematodes. Apparently more than one species was present in some of them, but one species, probably of the genus *Diplogaster*, was most abundant.

A small larval stage of this species was found to be the infective form. Most of the Nematodes in a host were confined to the cephalic region until it was dead. Many of the dead grubs contained numerous small infective Nematodes as well as others of medium and large size, some of which were females containing the young infective forms; the reproductive forms did not appear until some time after the grubs were dead, and they fed on the dead tissues. When a grub was left in a dish with distilled water, a few Nematodes usually issued, grew and reproduced, increasing to enormous numbers; they destroyed all of the grub except the skin and chitinous parts of the head. If most of the Nematodes were then removed and a fresh dead grub was placed with the remainder, another

enormous population appeared in a few days. Continued submersion of the grubs and Nematodes appeared to facilitate reproduction.

It was obvious that the Nematode attacked living, apparently healthy grubs, but it did not appear to be particularly destructive. There was evidence, however, that some tissue in living grubs is destroyed, and this probably increases mortality among them.

POTTS (S. F.). **Safened Forms of Calcium and Lead Arsenate.**—*J. econ. Ent.* **37** no. 2 pp. 314–315, 1 ref. Menasha, Wis., 1944.

The author summarises some of the results of investigations on the chemical, meteorological and physiological phases of arsenical injury to plants carried out by him in 1927–32 and 1941–42. Most plants give an acid reaction that is decidedly buffered to water deposited on their leaves, and this acid condition, with continual absorption of carbon dioxide from the air and leaves by leaf-surface moisture, is the principal factor concerned in the decomposition of arsenicals and Bordeaux mixture. An arsenical such as calcium arsenate, which is readily decomposed by dissolved carbon dioxide, may be relatively insoluble in tap water, but may in time break down completely on the plant. The addition of lime alone did not “safene” arsenicals or maintain an alkaline condition on the leaf surface. A high degree of arsenical solubility on the plant is always followed by poor adhesion; $\frac{1}{4}$ -inch of rain usually removes at least 90 per cent. of ordinary calcium-arsenate spray or dust deposit.

Dry-mixed preparations containing 1.5–2.7 lb. hydrated ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$) per lb. of commercial calcium arsenate were many times safer and adhered several times better than ordinary calcium arsenate. Preparations containing 2.3–3 lb. ferrous sulphate per lb. calcium arsenate were noticeably safer than those containing less than 2 lb. In most combinations the addition of lime increased injury. A slight reduction in insect toxicity that occurred in some safened mixtures seemed to be correlated more with the proportion of lime in the mixture than with the proportion of ferrous sulphate. Omission of some of the lime used in preparing commercial calcium arsenate might lower the quantity of ferrous sulphate required, make a safer compound and lessen the danger of lowering toxicity to insects. Tank-mixed sprays containing 1.6 lb. ferrous sulphate and 0.4 lb. hydrated lime per 1–1.5 lb. lead arsenate and dry-mixed preparations containing 0.25 lb. lime and 1–2 lb. ferrous sulphate per 3 lb. lead arsenate were very adhesive and highly safened without loss of toxicity to insects.

Materials that were found to impart the greatest degree of safening to arsenicals were ferrous sulphate, aluminium sulphate ($\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$), Bordeaux mixture, and in some cases a small quantity of lime when the mixture contained certain sulphates. Bordeaux mixture made arsenicals adhere better, and on most plants greatly reduced the injury; however, Bordeaux mixture is toxic to some plants, notably species of *Prunus* (including *Amygdalus*). Heating powdered samples to 160°F. for four hours had little or no effect on their phytotoxicity or their toxicity to insects. Safened powdered arsenicals were not adversely affected by storing for a year.

Safened materials were successfully applied in the form of dusts, dilute sprays and concentrated sprays. They adhered remarkably well, so that effectiveness was increased and the numbers of applications necessary reduced. Safened calcium- and lead-arsenate spray residues gave good kill of the larvae of *Anisota senatoria*, S. & A., after six weeks of exposure, whereas commercial calcium arsenate thus exposed gave practically no kill. Wild black cherry trees sprayed with 3–6 lb. standard calcium arsenate per 100 U.S. gals. water were completely defoliated, whereas the foliage of similar trees that were sprayed with 3 lb. safened calcium arsenate per 100 U.S. gals. water was in excellent condition after 75 days. Peach foliage reacts similarly.

McLEAN (H. C.), WEBER (A. L.) & JOFFE (J. S.). **Arsenic Content of Vegetables grown in Soils treated with Lead Arsenate.**—*J. econ. Ent.* **37** no. 2 pp. 315–316. Menasha, Wis., 1944.

As many enquiries were received by the New Jersey Agricultural Experiment Station in 1943 on the safety of using vegetables grown in soils that had been treated with lead arsenate for the control of the Japanese beetle [*Popillia japonica*, Newm.], various common vegetables were grown in plots treated with 250, 500 and 1,000 lb. lead arsenate per acre, by incorporating it into the surface four inches of soil a week before planting, or on the site of an orchard that had been heavily sprayed with arsenicals until about ten years before.

From the results obtained it is concluded that arsenic added to soils or present in them as a result of spray residues is absorbed by most vegetable crops in small quantities. The absorbed arsenic tends to accumulate in greater quantities in the tops of plants than in the roots, and the quantity absorbed varies for different crops. Among the vegetables tested, onion tops had the highest arsenic content (2.25 parts arsenic trioxide per million); none contained as much as 3.6 p.p.m., the maximum amount allowable on fruits or vegetables shipped in interstate commerce. Arsenic absorption by individual crops was directly related to the quantity of arsenic in the soil, but it would appear that there is no danger in growing vegetables on such soils, as if the arsenic content of the soil is extremely high, the plants do not survive. Arsenic residues persist for a long time in the surface few inches of soil and may cause injury to sensitive plants, such as lima beans; deeper ploughing, by mixing the arsenic with the lower layers of soil and thereby reducing the concentration at the surface, decreases the danger of such injury.

MEDLER (J. T.) & O'NEAL (E. J.). **Further Tests of Dusts in Control of Mirids and Pentatomids.**—*J. econ. Ent.* **37** no. 2 pp. 316–318, 2 refs. Menasha, Wis., 1944.

In tests carried out in New Mexico in 1942, dusts of arsenicals and sulphur were applied against adults of *Lygus oblineatus*, Knight, on sugar-beet plants in field cages. In cages treated on 13th–16th June, the control percentages in 72 hours, based on Abbott's formula [*R.A.E.*, A **13** 331] were 100 for calcium arsenate in conditioned dusting sulphur (33 : 66), 99.2 for Paris green in conditioned dusting sulphur (7 : 93), 97.2 and 94.7 for unconditioned dusting sulphur with calcium arsenate (66 : 33) and with Paris green (93 : 7), and 93.3 and 87.5 for conditioned and unconditioned sulphur alone. In cages treated on 20th–23rd June, sodium arsenite and unconditioned dusting sulphur (14 : 86) gave 97 per cent. control, and unconditioned dusting sulphur alone, with calcium arsenate (66 : 33) and with Paris green (93 : 7) gave 95, 90.1 and 91.1 per cent.; sulphur containing basic copper arsenate (64 : 36) or Calgreen [a proprietary preparation of calcium arsenate and Paris green] (66 : 33) was less effective. In cages treated on 23rd–26th July, conditioned dusting sulphur gave complete control when applied with sodium arsenite (86 : 14) and 94.9 per cent. when applied alone. Some of these combinations were tested against *L. hesperus*, Knight, and *Chlorochroa sayi*, Stål, and though less consistently satisfactory results were obtained, combinations of sulphur with calcium arsenate or sodium arsenite both gave relatively high control.

In tests with combinations of arsenicals, conditioned dusting sulphur and a pyrethrum dust (Pyrocide) against *Murgantia histrionica*, Hahn, a mixture of Paris green and sulphur (7 : 93) with Pyrocide to give 0.25 per cent. pyrethrins gave 95.7 per cent. control in 72 hours in cages treated on 21st–24th August and 94.7 per cent. in those treated on 28th–31st August. Sulphur containing Pyrocide to give 0.5 per cent. pyrethrins, or sulphur, rotenone and inert material (43 : 0.75 : 66.25) gave complete control in the second test. Sulphur

with calcium arsenate (66 : 33), Pyrocid (to give 0.25 per cent. pyrethrins) or both, and sulphur with Paris green (93 : 7) were less effective. All the combinations used in these tests gave complete control when applied against *L. oblineatus* on 23rd–26th July.

YEAGER (J. F.) & MUNSON (S. C.). **Relation of Dosage to Survival Time of Arsenite-injected Roaches.**—*Science* **100** no. 2605 pp. 501–503, 1 graph. Lancaster, Pa., 1944.

In experiments carried out for several years on the mode of action of sodium metarsenite on *Periplaneta americana*, L., various concentrations of the poison in volumes of saline proportional to the body weight were injected into the insects and the survival times were determined. When survival times were plotted against concentrations, hyperbolic curves characterised by a critical zone and a region of inflection were obtained. The critical zone is a region, usually associated with long survival times, in which insects receiving equal doses of the poison have survival times that fall into a bimodal frequency distribution or actually into two separate groups, and the region of inflection is one in which slightly different concentrations of the poison may cause the same survival time, or the lower dosage may cause the shorter survival time.

The authors explain the latter anomaly by the effect of dissociation on the mode of action of the poison. They postulate that the toxic action depends on the degree of ionisation of the compound; that the arsenical ion thus formed, or a secondary material dependent on its formation, combines with certain vital tissue components in a fundamental lethal reaction; and that the death of the insect is a result of a certain minimum quantity of the arsenic combining with a unit quantity of the tissue component. Equations are evolved in which the influence of dissociation is taken into account; survival times calculated by these agree well with observed survival times even in the region of inflection.

It is considered that these equations are of general applicability in studies involving the action of compounds, such as sodium metarsenite, that exist in solution in two different forms in a condition of equilibrium. The good agreements obtained by their use support the underlying hypothesis and indicate that the effective concentration is not necessarily the concentration of the poison that is injected into the insect, and that the anomaly represented by the region of inflection is the result of variations in the degree of dissociation at different concentrations.

STRONG (W. J.). **Currants and Gooseberries.**—*Bull. Ont. Dep. Agric.* no. 440, 23 pp., 8 figs., 1 ref. Toronto, 1944.

A section of this bulletin, by R. W. Thompson (pp. 21–23) contains brief notes on the damage caused by the principal pests of currants and gooseberries in Ontario and on the appearance, life-history and control of some of them. They comprise *Nematus* (*Pteronidea*) *ribesii*, Scop., *Aegeria* (*Conopia*) *tipuliformis*, Cl., *Agrilus rubicola*, Abeille, *Capitophorus ribis*, L., *Quadraspidiotus* (*Aspidiotus*) *perniciosus*, Comst., *Lepidosaphes ulmi*, L., and *Tetranychus telarius*, L.

PAPER NOTICED BY TITLE ONLY.

BREAKEY (E. P.). **The Effect of Methyl Bromide Fumigation on the subsequent Development of the Croft Lily** [*Lilium longiflorum*].—*J. econ. Ent.* **37** no. 2 pp. 277–279, 6 figs., 4 refs. Menasha, Wis., 1944. [Cf. *R.A.E.*, A **33** 24.]

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